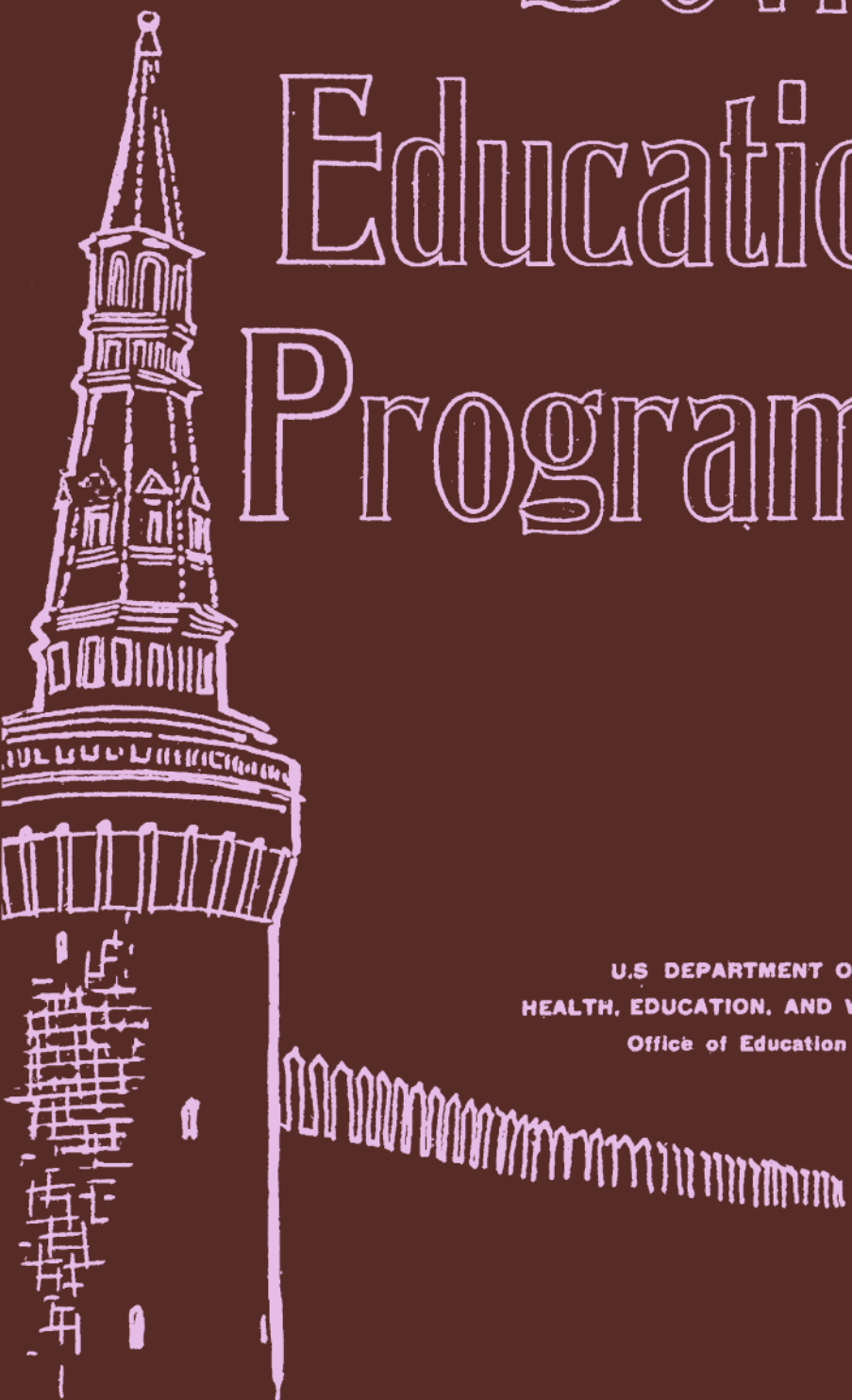
Soviet Education Programs



U.S DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
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Soviet Education Programs

- **FOUNDATIONS**
- **CURRICULUMS**
- **TEACHER PREPARATION**

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Foreword

THE CONTINUING INTEREST which American educators and other citizens have attached to Soviet schools and their development has served to encourage the U.S. Office of Education in its efforts to provide the most complete and verified information obtainable on the subject. As expressed in our *Soviet Commitment to Education, Report of the First Official U.S. Education Mission to the U.S.S.R.* "We are convinced that it is important for the American people to examine the Soviet program closely and to keep up-to-date on the developments and trends in Soviet education."

In pursuit of these aims, the Office of Education sent a second official group of specialists to the U.S.S.R. in the spring of 1959 with the specific objectives of looking carefully at the teaching methods, the general facilities, and the student performances in areas of education particularly emphasized by Soviet authorities in the general school system. At the same time, it was deemed important to study both the foundations and the balance between science and nonscience subjects in the curriculums of Soviet education. The three specialists—William K. Medlin, Clarence B. Lindquist, and Marshall L. Schmitt—under the guidance of Dr. Medlin, the Division of International Education's Specialist in Comparative Education for Eastern Europe, spent a month (May 9 to June 6, 1959) in the U.S.S.R. for these purposes. The present report is the result of their findings.

This Bulletin is the third major study in as many years prepared and published by the Office of Education on education in the Soviet Union. It was preceded by *Education in the U.S.S.R.* (Bulletin 1957, No. 14) and by *Soviet Commitment to Education* (Bulletin 1959, No. 16), released in September 1959. Both of these publications cover extensively the programs of education which have been in effect in the Republics of the Soviet Union in recent years. The current publication deals specifically with the foundations, science and polytechnic curriculums in the general school, and with teacher preparation.

It is our hope and belief that the authors' findings in such areas will prove especially useful to organizations and individuals seeking factual and documented information concerning *Soviet Education Programs.*

Lawrence G. Derthick

Commissioner of Education

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THE OFFICE OF EDUCATION expresses its sincere appreciation to all individuals and institutions in the U.S.S.R. that in various ways contributed helpful information and services toward making this bulletin possible.

The authors have expressed particular appreciation of the helpfulness given them by leading educational workers in the Russian, Ukrainian, and Georgian Ministries of Education, and by workers in their city and rural schools. Directors of pedagogical institutes, and directors of schools, professors, other teachers and students, educational researchers, and many other individuals also were among those whose cooperation was of great value to the Office of Education research team visiting in the Soviet Union during the spring of 1959. These visits resulted in the development of this bulletin reporting on *Soviet Education Programs.*

OLIVER J. CALDWELL,
Assistant Commissioner for International Education

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International Educational Relations

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Introduction

AS THE SECOND GROUP of educators sent by the U.S. Office of Education to the U.S.S.R. under the Soviet-American cultural exchange agreement, we were prepared to study specific aspects of education in that country. From the experiences of those who had gone before us, we had understood and anticipated that these aspects were particularly emphasized by Soviet educational authorities: the basic formation in mathematics, natural sciences, and polytechnic knowledge related to economic production. Since most educational systems and their curriculums are shaped by fundamental concepts and policies, we were naturally interested in those features which are termed the foundations of Soviet and Russian education. Similarly, it proved useful in our study to examine the general principles and methodological framework according to which Soviet teachers work and through which some of the special practices in Soviet education can be interpreted. We also went to Russia aware of the major reform movement underway in education there, and with the intention of seeing as closely as possible the features of the reform and their implementation in those schools which were in a state of transition.

From the moment we stepped into the Soviet jet TU-104 in Copenhagen, which would wing us seemingly without effort to Moscow within 3 hours, we sensed the technological push that later would be evidenced to us in the educational work going on in the Soviet Union. As we flew over the northern flank of the broad East European shelf and into the heart of Russia, we were able to glimpse some of the vastness (over 8 million square miles) of the land whose schools were to be our host. At the same time, we tried to disabuse ourselves from a concern with the geographical extent of this visit, taking comfort in the fact that the nine educators and Commissioner of Education Derthick in 1958 had accomplished a great deal in that direction and had come back with a keen awareness of the great commitment of Soviet peoples to education. We knew too that the vastness of the Soviet Union was knit together educationally by a unified system of general education administered

through central political controls. With these notions in mind, we decided to concentrate our school visit in the Western regions of the U.S.S.R. Authorities in the Ministry of Education of the Russian Soviet Federated Socialist Republic at Moscow, which was our official host, kindly agreed to arrange for us visits not only in Russia proper but also in Ukraine (south of Russia) and in Georgia (in the Caucasus), which are 2 of the other 14 Soviet Republics comprising the U.S.S.R. (See p. XVI for a list of places and schools visited.)

In the school classroom and workshop, in the machine building plant, in the countryside, and wherever we went, we felt the pulse of the Soviet Government's drive to educate and train a new generation of technically skilled and scientifically literate citizens. In the field of general and teacher education, we tried to examine as closely as possible the foundational aspects of their school enterprises, as well as the work of their teachers and students in the areas of mathematics, science, and polytechnic courses. While our efforts were limited to a month's visit, we saw elementary-secondary schools and teachers colleges of various sizes located in different cultural regions. We attempted to limit the number of visits and the distances travelled in order to concentrate on certain programs of study and on certain schools. We spent 2 to 3 days in some institutions for this purpose. By this approach we accomplished a considerable amount and feel that in the main we achieved our mission.

Even so, our visits cannot be judged as fully representative or complete for the educational sectors we sought to study. Schools vary significantly in composition and quality in most countries, and the U.S.S.R. is no exception. We saw some of its best schools and some of its average ones. Naturally, we have attempted to make effective use of official Soviet materials on educational programs and to verify through our visits the teaching described therein. We lay before the reader our findings, hoping that they may prove to be worth the efforts expended. This study is essentially a descriptive one within the framework of comparative education. It is not, however, by virtue of this relationship a *comparative* study or interpretation. We direct the reader to Chapter V, "Conclusions," for our final statement on the matter.

The conception and purpose of our mission were not only educational and technical, but also partly cultural. Under the exchange agreement on cultural relations between the Governments of the United States and the Soviet Union, signed on January 27, 1958, and renewed on November 21, 1959, educators from both

countries are exploring the ways of living and thinking in each other's country. For us, travelling and observing in the U.S.S.R. were thrilling cultural experiences. Our hosts in Moscow, Kiev, Tbilisi, Leningrad, and outlying points were most attentive to our interests and helped us take note of long-established traditions and ancient monuments that mark the way their peoples have trod across the centuries. They took us to musical concerts, theatrical performances, and art exhibits that testified to their many accomplishments in these fields. We left their country with many new impressions and with some added assurances about the usefulness of cultural exchange.

In the pages that follow, a certain division of labor was followed throughout. Writing and research of the first and fifth chapters were the primary responsibility of William K. Medlin; the second and fourth chapters, of Clarence B. Lindquist; and chapter three, Marshall L. Schmitt. All three authors collaborated in providing the documentary materials in the appendixes, in advising each other on their respective tasks, and in supplying basic interpretations for the chapter on conclusions.

Schools and Institutes Visited

I. 7-year, 10-year, and 11-year Schools

Name	*Type*	*Location*	*Enrollment*
Number 204	11-year	Moscow	1,050
Lenin School (rural)	11-year	Gorki-Leninskie	650
Number 12	Boarding	Moscow	300
" 14	10-year	Zagorsk	1,500
" 20	7-year	Zagorsk district	340
" 16	11-year	Moscow	1,037
" 57	10-year	Kiev	880
" 112	10-year	Kiev	657
" 6	10-year	Kiev	723
" 43	10-year	Kiev	1,150
" 44	10-year	Kiev	1,200
Sagaredzho (rural)	10-year	Georgian S.S.R.	916
Number 5	Vocational-Technical[1]	Tbilisi	----
" 4	11-year	Leningrad	1,025

[1] A 4-year program based on 7 years of general education.

II. Teacher-Training Institutions

Name	*Location*	*Total enrollment (day, evening, and correspondence)*
Krupskaia Pedagogical Institute	Moscow	7,500
Lenin Pedagogical Institute	Moscow	4,000
Pedagogical School Number 2	Moscow	530
Gor'kii Pedagogical Institute	Kiev	3,050
Pushkin Pedagogical Institute	Tbilisi	5,708
Hertsen Pedagogical Institute	Leningrad	16,500

III. Inservice Institutes for Teachers

Name	*Location*	*Total enrollment*
Inservice Training Institute	Leningrad	3,500
Inservice Training Institute	Moscow	6,000[2]

[2] Total annual registrations. Regular enrollments in weekly courses are 2,500.

IV. Pedagogical Research Institutes

Name	*Location*
Methods of Teaching	Moscow
Theory and History of Education	Moscow
Defectology	Moscow
Psychology	Moscow
Psychology	Kiev
Pedagogy	Leningrad

Collaboration in research, interpretation, and technical preparation of documentary materials was provided by Nicholas J. Rokitiansky of the Division of International Education.

CHAPTER 1

Foundations of Soviet Educational Practices

THE PRESENT SYSTEMS of schools and educational methods in the U.S.S.R. are outcomes of many and complex factors and developments—historical, economic, social, psychological and cultural—as well as educational theories derived from these areas and scientific investigations into education. In order to help us understand the school programs and how they function, this chapter will briefly analyze those factors in their relationships to current educational practices, and will consider the status of Soviet education today.

In Russia, public school systems are, historically speaking, a recent phenomenon, and popular instruction in knowledge about the world developed later than in most other societies in Western civilization. During the 18th century, the first secular schools were small and, for the most part, socially exclusive. Only in the latter half of the 19th century did the Russians succeed in establishing some basis for the expansive developments we are witnessing in the 20th century. Early efforts were small and usually came from the initiative of the crown.

During the last decades of the 1800's and especially the years prior to the 1917 Revolution, popular movements for education brought steady increases in school facilities. These late beginnings were primarily responsible for the relatively narrow national bases on which Soviet educators began to build a public schools system in the 1920's and 1930's. Particularly since 1930, therefore, a rather phenomenal growth has occurred in educational facilities in the U.S.S.R., moving steadily in the direction of universal, compulsory general education. In recent years, this movement has tended toward the goal of universal high school education, but had not reached that point when major reforms were enacted into law late in 1958. During this period of rapid

growth, curriculum and methods have responded primarily to economic requirements of society.

Historical Problems

ECONOMIC DEVELOPMENT

Historical problems of Russian education can be written largely in terms of economic and social conditions. Until late in the 19th century, the material exploitation of Russia had progressed slowly. Linked closely to this situation was the main social problem of serfdom, which was legally abolished during the 1860's. The availability thereafter of skilled manpower for economic growth became primarily a function of school facilities.

In other major European countries and in America, industrial growth and applied science had advanced, during the last half of the 19th century, at a much greater pace than in Russia. As the urgencies, after 1900, for the material exploitation of the country and for securing its international position pressed against the capacities of the people, it became evident that educational facilities would have to be developed at great speed in the decades ahead. Since 60 percent of the adult male population were illiterate in 1900, a massive educational effort was deemed necessary to transform this situation into one where new skills and scientific inquiry could meet national needs. The rate of Russian industrial growth progressed rapidly after 1900 and, during the Soviet period, was set at ambitious paces through the 5-year plans beginning in 1928, which is a chronological demarcation point in Soviet society. Because of the country's recent economic development and since Soviet authorities have established priorities sharply favoring heavy industrial production, educational programs have been designed to meet those fundamental needs. The proportion of total planned investment in the national economy going into heavy industry has been and is to continue to be 70 percent in the new 7-year plan (1959–1965).

The proportions of the adult population employed in various sectors of the economy are similarly indicative of industrial emphasis. As of 1956, according to Soviet statistics, 85.2 percent of the adult population were employed in productive branches of industry and agriculture; only 14.8 percent were working in administrative, distributive, and welfare services, including educa-

tion.[1] These factors have definite effects on education, on the preparation for life that youth must receive in school. In conjunction with economic plans, the planning for and control over school programs are devised by central authorities and administered by national, republic, and local organs of government functioning along a decentralized pattern.[2] The main tasks of U.S.S.R. schools over the past 30 years have therefore been to train youngsters for the government's planned economic programs and to inculcate devotion to its political and social system.

SOCIAL DEVELOPMENT

The Russian Empire entered the 20th century with a highly stratified social structure that was undergoing strains and great pressures for change, and changes were in fact rapidly taking place in Russian society. At the top of the social pyramid were the Emperor (Tsar), his family, and related imperial and princely families. A landed and titled nobility with extensive privileges ranked next, followed by a sizable class of officials whose upper ranks enjoyed prestige conferred by their positions and economic status. Entrepreneurs and men of commerce were not numerous, but they were important in the social and cultural, as well as economic, life of the towns. The Russian clergy composed another distinct social group having its own somewhat corporate character. Taken together, these social groups accounted in 1900 for about 3 percent of the total population. In terms of educational opportunity, their children constituted about 40 percent of the total enrollment in secondary schools of the Ministry of Public Instruction.[3] In institutions of higher learning, 61 percent of the students in 1914 came from these social groups.

Persons employed in agriculture, including small holders, and in industrial enterprises together accounted for approximately 87 percent of the total population. Their children made up 57 percent and 39 percent of the enrollments in fee-requiring secondary schools and higher institutions, respectively. The late emergence (after 1860) of Russian masses from the conditions of serfdom

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[1] S. G. Shapovalenko, *ed. Soedinenie obucheniia s proizvoditel'nym trudom uchashchikhsia.* (Combining instruction with production work of pupils.) Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1958. P. 7.

[2] *Soviet Commitment to Education.* U.S. Department of Health, Education, and Welfare, Office of Education. (Bulletin 1959 No. 16.) Washington, U.S. Government Printing Office, 1959. P. 8.

[3] Total enrollments (1914) in these schools were 556,487, but there were 135,769 pupils in other secondary schools, the majority of whom came from the social groups mentioned. Cf. Nicholas Hans, *History of Russian Educational Policy,* pp. 235–39; also, *Ezhegodnik Rossii* (Yearbook of Russia), 1906, St. Petersburg, *Tsentral'nyi Statisticheskii Komitet, 1907.*

made the rapid development of educational facilities both burdensome and urgent. This slow appearance of a free labor supply was closely related to Russia's tardy industrialization and social development, which in turn were hampered by the lack of a broadly based school system.

GEOGRAPHY

Bearing on the U.S.S.R.'s historical problems of economic and social development has been her geographical position. Steadily expanding from her European homeland after the 15th century, Russia came to occupy by the 20th century the vast Eurasian plain and plateau which, with little interruption, stretch eastward for thousands of miles to the Great Mongolian Plateau and, eventually, to the Pacific Ocean. These plain-plateau regions have served for over a thousand years as avenues for great human migrations and for building empires.

One major outcome of this situation is that the changing ethnic tides have left both islands of various cultures and mixed ethnic and cultural features that today give Soviet schools their particular imprints. Another result is that this immense region, until recently very sparsely populated and little developed in the central and eastern parts, has presented and continues to present a large problem for the manpower and resources development capacity of the nation.

The kinds of education, training, and related experiences which Soviet youth receive are closely related to these problems emerging from geography. They are factors, therefore, which should enter into any consideration of education in the Soviet Union. Our mention of them here merely points to their seeming importance and complexity.

SCHOOL SYSTEM

Years of war and revolution (1914–1921) delayed and disrupted building a national school system until the 1920's. These delays, followed by new economic priorities, had the effect of limiting education of the masses to the rudiments of literacy and elementary education. A systematic reestablishment of school systems came after 1928, when the Soviet Government launched the first in its series of priority economic plans. A minimum general education of 4 and then of 7 years was provided for all and, for those who qualified, desired to continue, and were admitted, a unified secondary school leading to the university or to specialized vocations was provided. During the period from

1935 to 1955, universal public education became a policy of the Government which made free and compulsory 7-year schooling available to the overwhelming majority of Soviet children whose grandparents, and many of their parents, had been either illiterates or the recipients of an elementary education only. By the 1955–56 school year, over 5 million youngsters were enrolled in academic high schools, and another 2½ million, in vocational, technical, and specialized schools beyond the 7th grade. The sociological aspects of this "educational revolution" in a little more than one generation invite attention, but are not the subject of this study.

Russian school systems prior to 1917 were, in general, similar to those which then characterized various European school systems. Three or four years of primary school were followed by enrollment in one of several different kinds of schools, independent of and parallel to each other: academic (college preparatory), vocational, technical, commercial, and so forth. Transfers into one of these or other specialized schools (*e.g.*, pedagogical or medical) might also occur at a later point in a pupil's general school program. The main feature of this parallel system, however, was its rigid socioeconomic framework.

The curriculum in the academic school was a "classical" or traditional type (emphasizing either the classics or modern subjects) and required the pupils to master much subject matter preparatory to studying for the professions (law, letters, medicine-dentistry, or technology) at the university. Under these organizational and curricular patterns, access to the liberal professions, intellectual enlightenment, and technical careers was limited to small proportions of the total young population.

After the establishment of the Soviet State, these patterns changed little in form but substantially in content, involving new selection criteria for advancement to secondary and higher education, and new subject matter as well as didactics. Particularly during the curriculum reforms of the 1930's did the traditional academic structure reaffirm itself in Russian education after a decade of experimentation. Absent were Greek, Latin, and religion as subjects, being replaced by modern languages, sciences, and political instruction. These general characteristics of the Soviet school system endured almost intact up to the 1958–59 school year, when new laws and large-scale experimentation began to work radical changes in Soviet educational practices.

One other characteristic of Russian education, not unrelated to recent policy developments, has been a historical concern for

manual, technical, and labor training in the schools. Already in the 1860's and 1870's some Russian educators saw the need for combining theoretical instruction with manual and practical work experiences. Some legislation and experiments led to curriculum changes in this respect, but these ideas did not become widespread in the schools of general education. Nonetheless, a certain tradition had been established, and we note that in the 1890's Russian educators advocated instruction in agriculture and in industrial work, which not only would help young people in the "real" world but also would inculcate (especially on children of the upper classes) respect for work and a sense of beauty in the realm of physical forms.[4]

POLITICAL SYSTEM

The vast regions of the Russian Empire (now the Soviet Union) were ruled for centuries by highly centralized institutions of Government. In the development of educational policies and institutions as well as in other activities of society, central authorities have exercised decisive influences. After a few months of a provisional government in 1917, a new form of centralized authority replaced the old imperial organs of government. Under firm Communist Party direction, the new Soviet Government continued a system of extremely centralized political controls. This system is officially termed by Soviet authorities a dictatorship of the proletariat.

Applying itself to education, this system exerts overall policy direction of educational developments and carefully worked-out measures of inspection and fiscal controls. Soviet education is administered, therefore, according to centralized ministerial principles traditionally practiced in many countries.

The several problems briefly touched upon here are the major ones which over many decades have been instrumental in shaping Russian schools, and which continue to exercise strong influences at the present juncture in the history of education in the U.S.S.R.

PHILOSOPHY AND CONCEPTS OF EDUCATION

The prevailing and official philosophy in Soviet intellectual, academic, and scientific work is dialectical and historical materialism (popularly called "Marxism-Leninism"). This philosophy teaches that matter, in its various solid, liquid, energy, or

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[4] See, *Report of the Commissioner of Education for the Year 1890–91*, Vol. 1 "Education in Russia," by Frances G. French. Washington, U.S. Government Printing Office, 1899. Pp. 242–261.

ethereal forms, is an absolute and eternal quantity. Based essentially on concepts of 19th-century physics, it permeates the basic courses in all curriculums to inculcate on students a "scientific-atheistic" understanding of the world.

According to Marxism-Leninism, society has historically developed and still develops in line with fundamental economic laws only, to which all other institutions, including education, are ancillary. These ancillary institutions are termed "superstructure." Schools are seen merely to reflect economic relations of society, in which pluralistic concepts are to have no place. Soviet philosophy admits that theory and practice interact and are modified. As Soviet economic and political programs have become ever more deterministic in all phases of life, these principles have in effect been oriented so as to construct a philosophy of education which appears to have pragmatic and perhaps expedient characteristics. These characteristics can be seen in the Government's recent decision to carry out extensive reforms in Soviet education.

Soviet philosophy envisages an ideal socioeconomic order (communism) for mankind and so endows itself with an *idealistic* nature. One must reckon with this idealism in examining the characteristics of Soviet society and its schools. The history of Russian philosophy before the Soviet period is marked by strong currents of idealism. This tradition appears not to have been lost in contemporary applications of dialectical and historical materialism, which at the same time provides a new frame of reference for social action in the field of education.

While materialism is the official philosophy, there appear to be other ideas which animate both intellectual life and educational philosophy, and which are at pains to find a source in the doctrine of dialectical and historical materialism. One of these is the overwhelming conviction, which one finds in Soviet educators and parents, that the primary path to a better future is through education, through intellectual improvement. This conviction motivates a great inner drive to master knowledge and its applications, an intellectual thirst that is prepared to endure other deprivations to satisfy itself. The U.S.S.R. Minister of Higher and Secondary Special Education recently expressed this faith to us in his own way when he said: "We in the Soviet Union believe absolutely in the victory of science; we believe that science leads to truth. We have everything to gain by giving our youth the best education possible." Other Soviet educators and teachers have expressed similar views. Such conviction is an article of

faith which draws its strength from deep motivation. Without it, Soviet school plans might be something different today.

"Free and universal public education" is another foundation of the Soviet system of education. Prior to legislation on the current reforms, the U.S.S.R. Constitution (article 121) stated: "Citizens of the U.S.S.R. have the right to education. This right is ensured by universal compulsory seven-year education; by extensive development of ten-year education, by free education in all schools . . . by a system of state grants for students of higher schools who excel in their studies; by instruction in schools being conducted in the native language. . . ." This provision has been amended to read 8-year and 11-year education, and to give education a polytechnic orientation. All schools except the military are coeducational.

Many of these various ideas about education and its philosophy are not peculiar to the Soviet period of Russian history only. They have their earlier traditions in the fabric of Russian culture out of which Soviet society has emerged over the past 41 years. Furthermore, loyalty to the homeland and to the authorities invested with the power to defend it is a longstanding national characteristic that continues to be a great significant force in today's Russia. The schools imbide and teach such traditions. Lenin himself, referring to cultural legacies of the past, acknowledged the worth of certain achievements made in imperial times: "We can build communism only on the stock of knowledge, organizations, institutions . . . human forces and means left to us from the old society," and "we must take what was useful" from the old school.[5]

Because of a return during the 1930's and 1940's to some principles of education practiced before the 1917 Revolution, Soviet educators have endowed their philosophy with a certain traditional or "essential" character. These principles include curriculum construction with a main emphasis on pupils' acquiring a definite amount of subject matter in all disciplines; the selective procedures for student promotions, based primarily on rigid, subject-centered examinations; and the organization of schools in different parallel systems. They have introduced the prerevolutionary concept of medal winners: "gold medal" and "silver medal" recipients. These students are the ones who have received all "A" grades or mostly "A" with some "B" grades, and these honors earn them preferential treatment in higher education.

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[5] V. I. Lenin. *Sochineniia.* (Works.) 4th ed., vol. 31. Moscow, Gospolitizdat, 1950. Pp. 259–261.

These principles of selection reflect a philosophy of education that views secondary and higher education as not the province of all those who want to obtain academic and professional preparation, but rather of those who qualify according to the selective criteria. The tendency of such a system is, of course, to make the upper grades and university years exclusive. As we shall observe later in this study, however, these principles are now undergoing transformation.

Important for Soviet educational thought has been the life work of Anton S. Makarenko, a Soviet Ukrainian pedagog who during the 1920's and 1930's developed a theory and system of education by working with derelict youth. Often working in opposition to officially announced educational principles and policies, Makarenko drew an important body of educational rules, methods, and moral principles directly from experiences in the school. Although these ideas were by-and-large not founded explicitly in teachings of Marx and Lenin, their "main object . . . was to demonstrate how collective discipline may be established and maintained," a goal which at length found support in the governing councils of the Soviet Union.[6] Today, Makarenko's work retains a high place in the thinking and practice of Soviet educators.

It is also instructive to examine the psychological foundations of Soviet education and their implications for a philosophy of education. Most psychological research in the U.S.S.R. concerns problems in the educational field. Like philosophy, Soviet psychology is founded on the materialistic, monistic concept of the world which recognizes only nature (or matter) as the source of mind and consciousness. The entire mental activity of man is seen as a reflection by his nervous system of the real world (the physical world) and of his relationships to this world. Man's spiritual development is held to consist of the development of the qualities of the personality, especially of its talents and abilities. Through instruction and a controlled environment, man conditions himself to using his qualities in the common social interest.

According to Soviet educational theory, children are fashioned by environment, by mentally absorbing their environment and then transforming these ideas into personal experiences. Environment includes almost everything in experience. These experiences are to be self-disciplining, conscious ones wherein the individual

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[6] Frederic Lilge. *Anton Semyonovitch Makarenko.* An analysis of his educational ideas in the context of Soviet society. University of California Publications in Education, vol. 13, No. 1. Berkeley and Los Angeles, University of California Press, 1958. Pp. 37–38.

Figure 1-1.—Returning from physical exercise, rural school, Moscow Oblast.

contributes his utmost to society while living in harmony, or in agreement, with it. Soviet patriotism—fidelity to the Soviet land and to the ideas of communism—occupies a leading place in this educational conditioning, and in this sense it gives the school a political character as well as a moral one.

Employing primarily the conditioned reflex theory as elaborated by Pavlov (1849–1936), Soviet psychologists have worked out a system of didactics which are strict and fixed in their conception and application; one might even use the term "narrow" to distinguish them from the broad scope of methods employed, for example, in most U.S. schools. Soviet psychologists maintain that fundamentally all (except physically disturbed or handicapped) children can learn the standardized subject matter through the teaching methods devised for all schools. By definition, therefore, they exclude from practical consideration many educational variables. Inherent differences exist among children, they admit, but only in small degrees. The curriculum, dominated until now by the so-called "hard" subjects, is designed to give all future citizens an intellectual foundation that is, in form, a traditional European one. This approach to education tends to give Soviet teachers a classroom control that appears complete.

Certain of their psychological research findings in the past are not the only explanation that we observe for this principle, however, and it is well to point out that Soviet psychologists have only recently been in a position to try out new methods in connection with a more diversified curriculum. As one Moscow educator pointed out to us in a discussion on methods, the researchers are not always successful in getting their results and viewpoints adopted in school programs. Psychologists and other researchers are busily engaged in work on such areas as development of the cognitive activity of pupils in the teaching process (especially in relation to the new polytechnic curriculum); simplification in learning reading and arithmetic skills in the lower grades; the formation of character and teaching moral values, including Soviet patriotism; psychological preparation of future teachers; the principles and methods for meeting individual children's needs (such as "self-appreciation"), in terms of handicaps and as regards a child's particular attitudes, peculiarities, and maturity; and understanding the internal, structural integrity of each school subject and its interrelationships with other branches of knowledge. These research activities are carried out under Soviet conditions and exemplify some of the major problems which educators there now face.

Although research goals are by and large established through planning, there is evidence of much purely experimental investigation, especially in educational psychology and education of the handicapped. It does seem to us, however, that limitations resulting from central control of research seriously handicap organic development; regional needs and individual creative innovations do not easily find accommodation in the official framework.

Soviet educators define their system as an all-round training whereby youth can participate in creating the conditions for a socialist, and, ultimately, a Communist society.[7] Such participation can become possible, they hold, only as students cultivate all the basic disciplines and only through a "steady rise in the productivity of labor . . ." which is linked closely with the educative process. School children and students are engaged in a total educational program which aims to teach them all the same basic subjects, morals, and habits in order to provide society with future workers and employees whose general education will make them socialist (Communist) citizens and contribute to their productivity upon learning a vocation (profession). A major task

[7] I. A. Kairov, *ed. Pedagogika.* (Pedagogy.) Moscow, Uch. Ped. Giz., 1956. Pp. 20–22.

now occupying Russian psychologists is to investigate the psychological conditions for improving the practical performance of pupils in prevocational school programs. Achieving this goal would have an effect on their productivity as adult workers.

Education and training in labor, therefore, form an important part of programs in educational research and in the regular schools. We have already noted some historical precedents in this direction during the late 19th and early 20th centuries. Soviet educators continued this concern for labor education, restating the theory in Marxist-Leninist terms.[8] After a variety of experiences in the early years of Soviet rule, the official study program for the general school became the "complex method," embracing all disciplines through a series of courses built on geographic schemes. The central theme of each phase or scheme was the work done by individuals and society to bring material surroundings into human service, and subject-matter was supposed to be introduced in order to develop understanding of the main theme. Socially useful work experiences were to be combined with this program. Many pedagogical and practical difficulties impeded its implementation, and the further development of this program, as well as Soviet pedagogy, was hampered by the reforms of the early 1930's, which came partly in response to the requirements of the 5-year plans.

Today, Soviet educators are enunciating new principles of labor education. While the new principles and programs use much the same terminology as that of former years, certain concepts and methods of implementation distinguish them from earlier practices. The basic philosophy of Soviet polytechnic education in the general primary-secondary schools is that education under modern technological requirements of society must include a basic understanding, in theory and in practice, of the operations of industry and agriculture. The philosophy postulates certain educative values to be derived from polytechnic training, such as understanding physical, natural, and mathematical laws; respect for labor activity and working people; and appreciation for complex processes in the course of material production. "The main task of the school is to prepare the up-coming generation for life,

[8] Lenin's original ideas on the subject are not extensive. A short summary of them is provided in N. K. Krupskaia, *Izbrannye pedagogicheskie proizvedeniia* (Selected pedagogical works), Moscow, Uchpedgiz, 1957, pp. 73–77. Krupskaia's own writings on polytechnic education are sizable.

for useful labor, to inspire in youth a deep respect for the principles of socialist society."[9]

These ideas seem to be transforming the Soviet general school into a major educative instrument for upgrading the technical-scientific competence of the entire generation. The school thus becomes a base for readapting the population, and particularly the young generation, to the changing techniques of modern industrial society. In this process, it appears to us that polytechnic education, combined with the traditional academic program, is emerging as a dynamic element in the philosophy of education in the Soviet Union.

Soviet educators point to the family and to youth organizations, as well as to the schools, as fundamental influences in the total education of children. Parents are encouraged to follow closely their youngsters' progress in school, to confer with teachers, and to serve on parent's school committees. Youth groups (the "Pioneers" and the "Komsomol") take the lead in stimulating and directing pupil initiatives, checking up on classwork and social performance, and applying forms of group punishment against recalcitrant members of the group (*kollektiv*).

The ideas and practices which we have reviewed here form a complex philosophy of education in which the authoritarian concept predominates. This philosophy at the same time recognizes flexibility and seems quite acceptable to changing conditions and views. Once a new concept is defined by the authorities, however, it is made to apply equally to all school districts and activities. Combining authoritarianism, elements of traditional education, faith in the power of education and in mass education, materialism, and educative values in polytechnic-labor programs, the Soviet philosophy of education stands today as a dynamic movement among educational philosophies of the world. Much evidence indicates changes in the philosophical foundations of education in the U.S.S.R., however, and it will require careful study in years ahead to determine what effects they have on educational philosophy.

SCHOOL ORGANIZATION

The political and economic contours of Soviet society largely determine the patterns of educational programs and organization. Planning and priorities are the leading factors here. At the base of the school system is a common program: a generally unified,

[9] Excerpt from a decree of the All-Union Komsomol Central Committee, in *Uchitel'skaia gazeta*, (Teachers newspaper), Feb. 28. 1959.

Figure 1-2.—Ten-year school, Zagorsk. Built in 1952.

universal, compulsory elementary schooling in grades 1–4[10] and a compulsory (nearly universal) 7-year education, or the "incomplete" secondary school.[10] This education provides the foundation for most all other educational programs, and normally all grades are housed in the same building. This latter principle applies also to the 10-year (or 11-year) school. Terminal in character, the 7-year school is followed by any one of several different kinds of schools which function parallel one to the other but under different administrative jurisdictions.[11] Thus, after receiving 7 or 8 years of general education, pupils may go into different forms of secondary education: 3-year general-polytechnical (leading to the university or to work in industry and agriculture), vocational (leading to industry or agriculture), technical (leading to industry, agriculture, and possibly higher education), semiprofessional (leading to industry or public services and possibly to a higher institute), and one of several forms of part-time general education. The last four educational routes may be anywhere from 6 months to 4 or more years in duration. The elementary-secondary boarding school is a new institution (since 1956) offering general-polytechnic education. Although we saw

[10] The 4-year elementary school is now in transition to a 5-year program; and the 7-year school is going into an 8-year program.

[11] *Soviet Commitment to Education*, pp. 5 ff.

education of this type, we did not make a special study of it.

Soviet educational policy requires a 6-day week for all school children. Saturday, however, is normally a shorter school day than the other days. The hours accumulated during a week, month, and year are impressive (see appendixes I to III for total hours per week from grade 1 and up). Over a 10-year period, the Soviet pupil spends approximately 10,600 hours in class and regular school activities. Under the new 11-year program, the total is planned to be well over 12,500 hours.

At the higher education level, we see another fractionalized system, where large numbers of separate and specialized institutions train highly qualified specialists in a few narrow fields, in response to economic and cultural requirements. For example, the medical, pharmaceutical, and veterinary institutes are outside the great universities. They are operated separately and come under the joint jurisdiction of the Ministry of Higher and Secondary Specialized Education, and an economic or functional ministry, such as the Ministry of Health or Ministry of Ferrous Metallurgy. While the State University of Moscow houses the basic faculties (departments) in the life sciences, a specialized school like the Timiriazev Academy of Agriculture at Moscow trains specialists in agricultural science and conducts research. Hundreds of such specialized institutes exist, working in relatively narrow fields.

This separation and the high functional specialization of Soviet university-level programs exemplify both Russian philosophy of education and conditions for educational development in the U.S.S.R. To help form a bridge between the foundational, theoretical training provided in the universities and the applied, specialized training given in the many institutes, there are the national (U.S.S.R.) Academy of Sciences, with its affiliates (such as the Siberian Branch), and the many Republic academies of sciences. Along with the higher education Ministry, these academies are responsible for planning and coordinating the theoretical and applied fields of scientific research. In the various departments (each grouping many disciplines) and many institutes of the Academy, the leading questions of science and methodology of research are considered. The leading members of the Academy are simultaneously the outstanding members of the university faculties. In such ways the Academy guides the scientific endeavors of the nation. A series of lesser academies responsible for the professions, such as education, fine arts, medicine, and architecture, perform similar functions in their respective fields.

Central Planning, Controls, and Methods

The Soviet economy has been geared since 1928 to a series of 5-year plans and now is engaged in an ambitious 7-year plan (1959 to 1965). These plans have consistently emphasized heavy industrial production, and even the new 7-year plan envisages 70 percent of total investments for the heavy industry sector.

The demands on the schools are closely related to these plans and emerge from decisions made by the State Planning Committee's (Gosplan) educational department. The various educational agencies must implement these plans, and the laws on which they operate provide the directions for meeting planned manpower needs. It is because of this planned development that Soviet educators are able to say to foreign educators that in the U.S.S.R. there are "no shortages" of specialists and teachers, since each succeeding year requires the training of specific quantities (quotas) of personnel.

To implement the planned training programs, two orders of control are exercised. The first is essentially political, drawing its authority from the central organs of Party and Government. The main operative agency for general education in each republic, the ministry of education, has central powers over all the school districts in the republic. The curriculums that it establishes are obligatory for all schools, so that the number of hours devoted to chemistry in a 10-year Moscow school will be the same as that in a 10-year school at Irkutsk, Siberia, other things being equal. This latter practice is control of the second order: educational control. Through its published curriculums, textbooks, methods manuals, and examination booklets the ministry controls the day-to-day work of the schools. An elaborate inspectorate system verifies from time to time a school's performance in every subject and activity.

PRINCIPLES AND METHODS OF INSTRUCTION

Principles of the teaching process provide a set framework for classroom teachers and are considered obligatory for them to observe. These basic principles were announced by the highest Government authorities at the outset of the major reforms in Soviet education in 1931–1932.[12] In accordance with these requirements, definite methodological solutions have been provided

[12] See M. M. Deineko, *comp., Spravochnik direktora shkoly* (Manual of the school director), Moscow, Uchpedgiz, 1955, pp. 17–31; also, *Biulleten' Narodnogo Komissariata po Prosveshcheniiu R.S.F.S.R.* (Bulletin of the People's Commissariat for Education of R.S.F.S.R.), 1932, No. 49, Article 638, Sept. 5, 1932.

over the years for each subject. The major feature of the Soviet curriculum is the parallel method of presenting subject matter, both internally with respect to each discipline and externally with respect to interdisciplinary relationships. While this feature appears strongest in the fields of mathematics and the sciences, it is used to some extent also in the social sciences subjects.[13] By this method, facts and skills are learned about two different areas of a subject, such as mathematics, during the same period of instruction (that is, the same term or semester). Similar learning activities occur in physics or in geography, and the knowledge acquired in each of these subjects may also be related to knowledge or skills acquired in another discipline.

As we have already pointed out, Soviet pedagogy has a distinctively traditional or "essential" character as far as form is concerned. Content is another matter.

One of its cardinal principles is that "the development of abilities is impossible without a systematic mastery of scientific knowledge."[14] In practice this means learning prescribed amounts of data through emphasis on drills. The construction of the curriculum and the main body of teaching methods sharply reflect this principle and are representative of long-established practices of European education. Learning is developed through individual, separate subjects in systematic, logical, and interrelated forms following the elementary grades (1–4). Sequences are carefully worked out for each subject, normally based on 2, 3, or 4 hours of instruction per week. Certain "hard core" subjects, like the mother tongue and mathematics, are taken 6 or more hours per week until the high school level.[15] Soviet educators strongly maintain that each subject has its own, distinct body of knowledge which must occupy a corresponding place in the general curriculum. Teaching concepts that advocate merging of disciplines into such integrated courses as social studies or general science are shunned by them. They do not use any unitary measuring device for curriculum analysis or construction, such as the American Carnegie Unit. Subjects are given different emphases according to the values, both educative and utilitarian, that officials responsible for educational plans determine appropriate to their society's needs and schools' tasks.

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[13] See examples given in Bruce R. Vogeli, *The Mathematics Program of the Soviet Secondary School. Its Status and Innovations.* Unpublished doctoral dissertation at the University of Michigan, Ann Arbor, 1959.

[14] Kairov, I. A., *Pedagogika* (Pedagogy), p. 94. It is not intended here to discuss the problems of defining what is "scientific knowledge" in Soviet contexts, but rather to point out a governing principle within the Soviet framework.

[15] See appendix I, table B, p. 219.

THE LESSON PLAN

The heart of teaching each subject is the daily lesson plan. Every hour of every subject has its planned instruction or activity, worked out in detail in writing by the teacher in accordance with the requirements of official syllabuses (*programmy*) and texts. All topics in the syllabus are supposed to be covered in class, and the textbook serves as the main instrument or aid.

The lesson plan provides the basic academic work of the class. It should be so constructed that the following major aims of the lesson are achieved:

1. *Clear objectives*—Pupils must receive factual data which enable them to acquire precise impressions and understandings; they must see relationships between phenomena, theories, and laws; they should be able to distinguish type-processes and acquire the habit of doing this; they should be trained to notice lacunae which may occur in a body of given knowledge.
2. *Union of the formative and developmental tasks in education*—Through rigorous study of subject matter (especially the sciences), pupils should understand the materialistic basis of the world, the class struggle in social development, and the ideals of communist morality; teachers must constantly develop the thinking, memory, awareness, discipline, and volitional qualities in children and inculcate habits of orderliness.
3. *Appropriateness of educational materials*—Pupils' ability to perceive ideas is strongly dependent on the material aids used in education; teachers must carefully select the correct and most useful means for impressing upon children new and related facts.
4. *Collective unity of the class*—Each teacher's individual qualities must be used in the lesson so as to get the entire class to succeed in its assigned work; the teacher strives to consolidate knowledge already learned by pupils, to improve their ability to acquire more, and to inspire all children to pull together in mastering the subject.

Along with the work of the daily lesson plan, homework is assigned in varying amounts, from the second grade up. Whenever possible, teachers relate assignments to the problems of everyday life and to environmental occurrences. From grade 5, homework is more closely related to the regular lesson plan and actually forms an extension of it. Ideally, home assignments are not to exceed 30 minutes for each main subject. Depending on the grade level and the number of times per week a subject is taught, homework varies from 2 to 4 hours a day, making an average total of 16 to 17 hours per week. Some Soviet educators with whom we talked were admittedly concerned about the amount of time pupils put into home assignments, and these educators were striving to improve classroom methods so as to reduce the homework load. They feel that the better training in both subjects and methods which a teacher receives will enable him to

enrich the learning process in class and thus lessen the load carried in after-school hours. Inservice training programs are playing an important part in this effort. One geography teacher in whose class the writers spent some time had eliminated all homework in world geography. Methods such as class projects in political and economic geography covered the prescribed subject matter in a way that left no work for outside completion.

In all the classes we visited, lecture by the teacher and recitation by pupils on specific topics assigned from the lesson plan were the main teaching methods employed. Particular examples of this practice will be found in subsequent chapters dealing with various teaching areas. Possibilities for pupils' voluntary expression and participation are limited; the essential feature of Soviet classroom pedagogics is that the pupil must master the prescribed topics and be able to perform correctly what is given or required in the textbook.

MARKING SYSTEM

The marking system used in Soviet education is a unified one consisting of five number values. These standards have been used since 1944. Briefly, the values for each number-grade are as follows:

5—Means that the pupil (or student) has acquired an exhaustive knowledge of the subject matter, according to the program (syllabus); he has solidly mastered and understands the material precisely; in oral or written examinations, the pupil provides correct answers to all questions, works independently, applies facts to practical situations, and employs correct language in all forms of expression.

4—Means that the pupil knows all the required subject matter in the program; he has grasped and understands the material well; in examinations, he answers questions without difficulty, can apply knowledge practically, does not make serious mistakes, and employs written language with only minor mistakes.

3—Means that the pupil commands the fundamentals of the subject matter as required; in applying facts to practical tasks he has some difficulties which are overcome with moderate aid from the teacher; in spoken and written expression he makes mistakes.

2—Means the pupil reveals ignorance of most of the required subject matter; he answers only leading questions coming from the teacher; he makes numerous, serious mistakes in written work.

1—Means that the pupil is completely ignorant of the subject matter.

No arithmetical averages of a pupil's grades for all subjects taken in the year are made by Soviet educators, and the level of performance reached at the end of the year determines the grade. Pupils who obtain marks of 5 in *all* subjects in the curriculum are named gold medal winners; those who receive marks of 5 in

all the final exam subjects and 4 in no more than three other subjects are named silver medal winners.[16] Both categories of students earn special academic privileges with respect to entrance into higher institutions of learning.

Children are also graded on their personal conduct, inside and outside the school. A mark of 5 is given for normal, satisfactory conduct. When a pupil violates rules and receives a 4, the school's educational council takes note and watches for any further violation. Should a serious infringement of normal behavior occur, a 3 is given, in which case a pupil may be subject to dismissal from the school. If a child does not correct his behavior after initial violations, and becomes subject to a 2, he will be expelled by the educational council. This latter decision requires approval by the district educational department.

One example of class grading observed by the writer was the marking given for reading. The fourth grade class was asked to turn in the book to an unfamiliar text. The first child called upon read fluently one paragraph and then was asked questions by the teacher on the passage for comprehension. With some hesitancy the pupil answered the questions satisfactorily. The teacher recorded a mark of 5 and spoke it loud enough for all to hear. A second pupil, reading a new paragraph, had some difficulty with words and did not completely satisfy the teacher with answers to questions about the text read. This pupil received a 4. A third child read a third passage with marked ease and much expression. She was able to retell the part of the story (from Jules Verne) without any difficulty. This pupil received a 5.

Fourth grade Russian language work is graded, according to an official statement on marking,[17] in line with the following standards: for a 5, in written work, the pupil must clearly understand the story in the text; relate its content faithfully and without factual mistakes or substantive imprecisions; observe sequence; have no defects in the use of words or construction of sentences; and have no more than one error in punctuation. In mathematics for grades 8 through 10, for a mark of 5 the pupil must carry out written work completely and correctly, including the various steps in reaching answers and the giving of proof wherever appropriate. A 4 is given when there are one or two mistakes in written assignments.

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[16] In 1959, final exams at the end of secondary school were required in Russian literature, algebra, geometry, physics, chemistry, history, and a foreign language.

[17] M. Deineko, *op. cit.*, pp. 249 ff.

In inspecting a number of school children's workbooks (copybooks) containing regular written work and quizzes, we noted that in the main the marking standards as established by Soviet educational authorities are maintained.

In school corridors and classrooms, one sees many posters and banners carrying quotations and slogans from Government and Communist pronouncements. Many of these quote Lenin, some Marx, and their apparent purpose is to inculcate on pupils the beliefs expressed in the quotations. For example, in an eighth grade biology class, we observed these two posted on the walls: "The human mind has discovered much that is unusual in nature and is discovering still more, thereby increasing its power over nature." (Lenin) "Philosophy merely explains the world in various ways, but the conclusion of the matter lies in the fact that the world will change itself." (Marx) In a polytechnic laboratory in physics, the following quotation appeared in large yellow letters on a red banner: "Communism—it is Soviet power plus the electrification of the entire country." (Lenin)

These and other quoted sayings from Communist leaders appeared to be aimed at invoking in young people a strong desire to understand and to master their material environment. In certain quotations, a clearly political as well as philosophic indoctrination was evidently intended.

OUTSIDE SCHOOL ACTIVITIES

While the classroom teaching process exemplifies the essential features of Soviet educational philosophy and methods, another important area of education and culture lies outside the regular school program. This area is the Pioneer organization with its many clubs and district or municipal "palaces." Existing separately or parallel to the school system, it nonetheless has very close ties with school programs. Adult leaders in the Pioneer activities come mostly from the teaching staff of the local schools. This relationship provides for a direct bridge between educational work in both school and club.

Every school participates to some extent in forming "circles" (clubs) at the local Pioneer house. Children with expansive interest in developing knowledge and skills are encouraged to join the Pioneer organization and to participate in the club activities. These activities may be built around a particular subject, like literature or chemistry, or around some problem in home-making or industry. An important aspect of the program would seem to be the emphasis placed on child interest and self-expression.

This feature differs markedly from the intensely subject-centered teaching we found in the regular school classes. Activities which we saw going on in the Pioneer Palace in Tbilisi, Georgian S.S.R., for example, indicated there are broad opportunities for children desiring to pursue special interests under the guidance of experienced teachers and specialists. We observed musical and dance performances both in Tbilisi and in Moscow that attested to the marked success of the Pioneer program in helping youngsters to develop their particular talents and to express cultural traditions that make for human individuality. Part of the Pioneer activities, on the other hand, concern moral and ideological up-bringing in line with patriotic and Communist principles, designed to inspire collectiveness and loyalty.

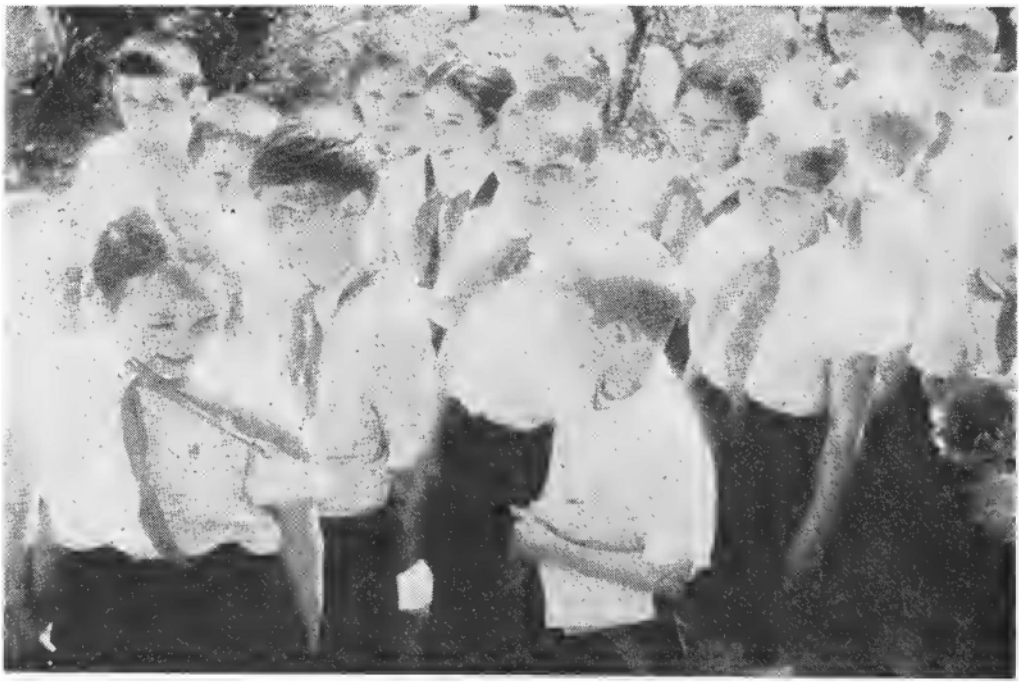

Figure 1-3.—Children waiting for school rally, Moscow.

PEDAGOGICAL AND EDUCATIVE LEADERSHIP

There are two concepts of school management besides what can be normally called administration (functions of director, assistant directors, educational council, etc.) that bear directly on pupils' progress and the success of the school program. These concepts are the respective roles of the "grade leader" or leading teacher *(klassovoi rukovoditel')* and of the special "tutor" or educator *(vospitatel')*. In order to comprehend these terms, one may well distinguish that which, in American practices, pertains

to academic and instructional matters from that which pertains to character formation and upbringing. Calling the first category "pedagogy" and the second "education," one is able better to see the distinction which Soviet educators make particularly with regard to the concept of "tutor" *(vospitatel')*. As we shall see, both the class leader and the tutor have functions which are distinctly educative under these definitions.

Each grade from the fifth up has its grade leader who has special responsibility for promoting the overall success of the school program for that particular grade. This leading teacher normally stays with a grade (embracing several classes or groups) over several years after once having been assigned to it. He encourages companionship, hard-working attitudes, and a spirit of purpose on the part of all children. The leader becomes well acquainted with his charges and knows how best to work with them, who need special encouragement or help, etc. Appointment to this position is made by the school director (principal) from among the best qualified and most experienced teachers.

The grade leader's specific and most important duties include: verifying that the pupils' learn the "Rules for Pupils;"[18] following the daily school work, activities, and duties of pupils; striving to inculcate a sense of grade unity and school pride; checking on the academic load, including homework, required of all children; holding occasional grade meetings to discuss common problems; scrutinizing pupils for their aptitudes, interests, problems, and initiatives, as well as helping them in meeting or responding to these various needs and interests; organizing extra-curricular (including outside school) functions; and developing relations between school and parents, including preparations for the selection of pupils for different school or occupational programs upon completing 7- and 10-year schooling.

The leading teacher is required to draw up a regular plan for these various activities, either on a quarter or term basis. He or she is obliged to follow this plan and to report on the results of the program at the end of each school year. The work of the grade leader forms an important support of the school director's administration, and he too is required to report annually on the progress of his school program.

The office of tutor *(vospitatel')* appears to be a new one along with the development of boarding schools in Russia. Besides his regular teaching assignments, the tutor's role is to pro-

[18] See U.S. Department of Health, Education, and Welfare, Office of Education. *Education in the U.S.S.R.*, Washington, U.S. Government Printing Office, 1957. P. 64. Bulletin 1957, No. 14.

mote among children character-building activities consistent with Communist social and moral aims. These activities, we were told, should develop self-reliance and self-confidence, individual skills and talents, and respect for human values and for the "collective" (*kollektiv*, or group). The tutor's activities are mainly concentrated in after-school hours, when he works closely with the Pioneer and Komsomol organizations in developing programs for cultural enrichment and ideological upbringing. One tutor, who held the rank of senior tutor, with whom the writers spoke at some length, was a geography teacher in the regular school program. This man appeared to be an extremely able person. He holds a university-level degree from the Lenin Pedagogical Institute which, he was quick to point out to us, used to be the Second Moscow State University. He had 16 years of experience in teaching, was a singer and musician, and apparently had a fine personality. We felt that here were some qualities evidently sought in selecting a person for the new job of school tutor.

This tutor and the pupils put on a "talent" show for us which, we felt, merited particular praise for its organization, development of abilities, and spirit of comradeship. The tutor himself led and participated in parts of the program. We observed his conduct of an eighth grade class and were impressed with the teaching skills he employed.

PUPIL PROMOTIONS

As indicated earlier in this chapter, evidence suggests that nearly all pupils manage to pass the academic program. Only occasionally did we notice children obviously too old for their grade. This information is corroborated by findings of other careful observers of Soviet schools.

While precise data on the overall success and promotion of children in the U.S.S.R. are not available to us, it seems useful to report our findings in some schools. In the village school at Gorki-Leninskie near Moscow, which is now an 11-year school developing a full polytechnic education program, we were told that 80 percent of the graduates of the 7-year program go on to the upper grades (8 through 10 and now 11). Those who do not go on and decide to go to work can continue their education in a vocational school or in evening classes, correspondence programs, or special schools for working youth. These latter three programs lead to an academic high school certificate. Graduates of the 10- and 11-year programs who go on to higher education amount to about 30 percent of the graduating class. Not all within

this 30 percent can, however, be enrolled in the day programs. A little less than half of them will be admitted on an evening or correspondence basis. Some graduates go to 1-year vocational schools in agriculture, where on completion of the courses they will receive a trade specialty (such as machine operator) which qualifies them for a certain wage. In a school in a Georgian town near Tbilisi (southern Caucasus), 28 percent of the 7-year graduates went the previous year (1958) into vocational and technical schools, while the other 72 percent continued academic education in the eighth grade.

At 10-year School No. 14 in Zagorsk, a city of some 50,000 people, 90 percent of the pupils normally go on to the eighth grade. Upon graduation from grade 10 in 1958, about 20 percent enrolled in institutions of higher education. This school had an enrollment in 1959 of 1,500. In a smaller, 7-year school near Zagorsk, 17 pupils graduated in 1958. Of this number, 13 went on to the eighth grade, 2 enrolled in a vocational school, and 2 others went to work. In Moscow 11-year School No. 16, nearly 100 percent of the 7-year graduates continue their education into grade 8. From one class of 31 students completing grade 10 in 1958, 14 were accepted by institutions of higher education. From among 70 graduates of grade 10 at School No. 57 in Kiev, 34 enrolled in day programs of higher education, while the others are working but continuing their education in part-time programs.

These samples of promotion ratios taken at random substantially confirmed information later given us at the Ministry of Education in Moscow regarding pupil advancements. We were told that in urban regions (including the rural environs of major towns) between 70 and 80 percent of the youngsters go on to secondary school after grade 7; and that in the farming or rural areas, the figures vary but are around 50 percent. A small percentage of pupils today do not complete the seventh grade.

Statistics published by the Soviet Government in recent years do not give us enough information to speak with authority about enrollments as percentages of total age groups. Until official data collected during the recent Soviet population census become available,[19] it is unwise to attempt to give precise figures on how many Soviet children out of a specific age group are enrolled in various educational programs. Information given to us in the

[19] Cf. *Vestnik statistiki* (Journal of statistics), Moscow, No. 5, 1959. Additional statistical data, released in February 1960 (*Izvestiia*, Feb. 4, 1960), can assist in further analyses of enrollment and promotion developments.

U.S.S.R. and other data enable us to point to the general directions of pupil promotions. From our visits in the western regions of the Soviet Union, it appears that there about half of the eligible age group is enrolled in the upper grades of 10-year (some 11-year) programs. Another not insignificant proportion is enrolled in secondary vocational and technical schools of various types. These proportions are not precise, and we were unable to have them verified. Pertinent to these considerations are the facts that approximately one-half of the entire Soviet population is rural, and that one-fourth of all children in the elementary grades (1 through 4) attend separate, 4-grade schools. As of 1955, 65 percent of these schools (rural and urban combined) had 40 pupils or less, and 57 percent of them had but one teacher. It is apparent from these data that the 10-year school, which incorporates all grades, has not yet become available to significant portions of the population. While some observers indicate that no more than one-third of all Soviet children have been going on to secondary education, we feel that this estimate may be somewhat low and that it likely has been closer to one-half. Recent changes obscure this picture. In either case, mass education now appears to be in effect in the U.S.S.R. The degree of success that Soviet teachers are having and will continue to have with their principles and methods of teaching will determine the level and quality of education in this mass system.

Problems and Changes in Soviet Education

The unified school system and curriculum produce kinds and degrees of uniformity and conformity that are quite unfamiliar to an American observer. At first, one might think that here is an educational structure without major problems. Looking at the day-to-day pedagogical performances in the classrooms, our reaction was that this description of the situation appeared somewhat correct. We did, however, sense immediately a certain formalism in the school's learning exercise, which provided no indication that children develop skills to use knowledge. Pioneer work affords this opportunity for some children, however. The plan of studies, outlines of courses (syllabuses), official textbooks, and daily lesson schedules all provide ready-made devices for teacher control over the learning process and for measuring the amounts of information acquired. Teachers know their methods, pupils are eager to learn, and parents (especially many of those

who received little education themselves) are insistent that Ivan go to school.

The picture is not so calm as it first appears, and many Soviet educators with whom we talked discussed quite frankly what they thought was wrong with their schools. Studying their comments and following their educational publications as well as announcements by Government leaders in the U.S.S.R., we have been able to identify some of the major problem areas in Soviet education and the general direction in which it is moving.

Since the last major reforms initiated during 1931–32, the Russian general school has been primarily concerned with developing a strong academic program. This concern centered on the subjects whose mastery provided a necessary foundation for higher education, especially in mathematics, physical-natural sciences, and the mother tongue. Educational research aimed primarily to provide solutions to methods problems in subject-matter teaching, and to disseminate its findings and the experiences of the best schools to the field. With the various manpower needs, regulated to planned quota systems, this policy appeared to be satisfactory until recent years.

New problems arose, however, in connection with the economic, social, and intellectual development of the country. Briefly, these problems are: An unbalanced curricular structure, which requires all pupils to take the same subjects throughout the 7- and 10-year school programs; swelling enrollments in secondary education during the period 1950–1957; an impending fall in the age-group leaving schools for productive activities in society; unfavorable psychological attitudes of youth, especially in regard to occupational training and physical labor; need for improvement in selection procedures and in evaluating pupils' achievements; and need for providing for individual children's differences. We saw evidences of certain of these problems in the schools, spoke with Soviet educators about them and others, and have followed discussions in the Soviet press concerning some of them.

CURRICULUM

Leading Soviet educators in the Pedagogical Academy and also some school principals feel that, in the main, the old programs of study[20] constituted too heavy a load for Soviet youngsters. Obvious needs have arisen to facilitate the acquisition of mathematics, sciences, and technical drawing to lighten the load for specific time periods, and to reduce the program in social studies-

[20] See appendix I, table A, p. 218.

humanities. In discussing this matter in the Institute of the Theory and History of Pedagogy, the Director was careful to point out to us that the overall aim is *not* to reduce the quality of education, in the academic sense, but to make learning easier and more accessible to all children. The new curriculums being worked out are planned to introduce much more practical work than was previously offered, and at the same time they will lessen relatively (but *not* absolutely) the load of academic subjects as compared to the old curriculums.

Curriculum development is also going on in order to teach educative values of practical work (in shops and agricultural plots) and of production work (in shops and factories, and on farms). Pupils will spend many more hours than heretofore on activities involving manual as well as intellectual skills. Backgrounds for this development are discussed later in this chapter.

ENROLLMENTS

As the Soviet Union moved toward universal 7-year education in the postwar years, pupil enrollments in the upper secondary grades began to swell way beyond the numbers normally required to meet higher education quotas. From 1950 to 1955, for example, the number of students in grades 8, 9, and 10 of the regular day schools increased by 350 percent (from 1.5 million to 5.2 million). While graduates from these grades during that period mounted to 1.5 million a year, annual first-time enrollments in universities and institutes have been held consistently to around

Figure 1-4.—Manual arts work in second grade.

450,000. In some anticipation of the need to supply future secondary school graduates with some specialized knowledge or skill, the XIX Congress of the Communist Party of the Soviet Union (C.P.S.U.) in October 1952 passed a resolution calling on the schools to devise ways of changing their programs: "With the aim of raising further the socialist, educative significance of the general educational school, and of securing for pupils who fulfill secondary school conditions the free choice of a vocation, it is necessary to proceed toward effecting polytechnic instruction in secondary schools and to take measures necessary for the transfer toward general polytechnic education."[21]

Educational administrators set to work on this problem and also on efforts to direct academic high school graduates to other programs. New postsecondary vocational-technical schools were opened in 1954–55 to train skilled workers, in addition to the already existing network of technicums and other specialized institutions. These latter two types, formerly organized mainly for receiving 7-year school graduates, expanded their facilities for offering training to persons with 8 or 9 years of education and to graduates of the 10-year program.[22]

In very recent years, however, upper secondary enrollments in the regular day schools have fallen off rapidly, to the point where in 1958–59 the number fell to 3,400,000.[23] This drop is primarily due to the very low birth rate during wartime conditions (1941–45), compounded by heavy losses of life, both military and civilian.

LABOR MARKET

The drop, after 1957, by one-half in the number of youths of working age will have an effect on numbers available for industrial and agricultural employment during 1960–1965. With this situation imminent and with needs for technically literate youngsters ever on the increase, the new polytechnic training program is being introduced at a time when it can help meet these problems and when enrollments are lower and more manageable. Low

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21 M. Deineko, *Op. cit.*, p. 186.

22 For example, see programs listed for the Moscow region in *Kudu poiti uchit'sia; spravochnik* (Where to go to study; a manual), Moscow, "Moskovskaia pravda," 1956, pp. 121–208; also M. Deineko, *comp., Gde poluchit' spetsial'nost'; spravochnik* (Where to receive a specialty; a manual), Moscow, Uchpedgiz, 1955.

23 Over 1.2 million others were enrolled in special schools for working youth and 1.1 million for adults, which offer complete academic programs. *Narodnoe khoziaistvo S.S.S.R. v 1958 godu.* (The national economy of the U.S.S.R. in 1958.) Moscow, Gos. stat. izdat., 1959. Pp. 114–117.

enrollments mean too that the costs in providing a technical basis for a full polytechnic program would not be so heavy as they would be at a time of normal enrollments.

The relationship between planned economic goals and the need for greater productivity is also evident in schools' polytechnic programs. Agreements between school districts and local economic councils of the Government provide production quotas for school shops on items such as grease cups, cabinets, sacks, boxes, etc. Rural schools produce marketable crops or animal produce. During the coming period of manpower decline, schools will thus be contributing something to the national economy.

YOUTH ATTITUDES

As more millions of youngsters took the academic curriculum preparatory for higher education, aspirations for entering institutions of higher education increased accordingly. The annual first-time enrollments at the university level remained practically constant, however, and opportunities for secondary school graduates to obtain a higher education failed by far to meet the number of eligible candidates. This situation had several effects. It intensified the competitions for entrance, which in turn led to abnormal and incorrect practices, by some educators and parents, that the Soviet Government has condemned.[24]

It produced some disillusionment among youths who place high value on admittance to higher institutions as a direct path to important state service, to prestige in society, and to high material rewards. Many thousands of young people preferred to wait for future openings in enrollments rather than to take manual labor jobs in industry and agriculture. Physical labor was looked upon as degrading.[25] Others, however, joined vast development programs such as those in the new agricultural districts of Soviet Central Asia.

As one corrective measure, work experience has become more and more important in relationship to access to higher education in recent years. Since June 1955, entrance has been preferentially granted to those who have acquired "not less than 2 years' experience in . . . the national economy and culture, and have been demobilized" from military service.[26] Medal holders, who are

[24] See N. S. Khrushchev, "Ob ukreplenii sviazi shkoly s zhizn'iu i o dal'neishem razvitii sistemy narodnogo obrazovaniia v strane" (On Strengthening the Ties of School with Life and on Further Developing the Country's System of Public Education), in *Izvestiia*, Sept. 21, 1958, p. 2, referring to such things.

[25] See, "Psikhologicheski gotovit' detei k trudu" (Psychological Preparation of Children Toward Labor), in *Uchitel'skaia gazeta*, December 4, 1958, p. 2.

[26] L. I. Karpov *and* V. A. Severtsev, *ed. Vysshaia shkola.* (The higher school), Moscow, "Sovetskaia Nauka," 1957. P. 39.

waived from taking entrance examinations, have not thus far been hindered by this provision. Soviet officials said that in 1957 about half of the first-year enrollees had had required work experiences (the larger proportions of those lacking experience were in scientific fields). In the fall of 1958, 68 percent of the new students had satisfied the work requirement. The Government's aim is to reach 80 percent.

Another effect of the old curriculum on youth, intimately related to the above factors, is to leave them unprepared for occupations in the national economy. Although they receive some basic education in the sciences and humanities, this knowledge is substantially unrelated to practical needs of industry, commerce, and agriculture. Additional training is required if they are to become productive persons in a new industrial society which is ambitiously forging ahead. More time and investment in training them cost the Government additional resources that could be used in other ways.

Apparently related to the problems in youth attitudes is a concern voiced by top Government leaders that some institutions of higher education are practicing abnormal entrance policies, particularly in the large urban areas. There is evidence that in these areas an unequal distribution of university enrollments has grown up with respect to the socioeconomic background of the students. The head of the Communist Party and of the Soviet Government himself, Mr. Khrushchev, has indicated that, for example, in the higher institutions of the Moscow area, "30-40 percent of the students are children of workers and peasants. The rest of the students are children of employees, the intelligentsia. Of course, such a situation is clearly abnormal." Criticizing the effects of parental influence in selecting young people for the university, he said that, "It is necessary that each young man and each girl, independently of whatever position their parents occupy, prepare themselves for labor activity on grounds common for all. A son and daughter should know that daddy is daddy, and they ought by themselves, by their own labor, earn the respect of people, and not live on the credit of their parents' attainments."[27]

SELECTION AND DIFFERENTIATION

The presence of vastly greater numbers of children in their midst caused leaders in secondary education to reconsider methods for identifying skills and talents. One of the important

[27] See, *Izvestiia*, April 19, 1958, and Sept. 31, 1958.

aspects of the new reform and its research program, we were told, is to develop curriculums that will help youngsters decide what they should do in both school and later life, what type of occupational career to follow, and what skills to develop.

Soviet educators are also more concerned now than in the past with differences among children. Their research, corroborated by reports from teachers in the classrooms, show that children have different rates of learning, often indicate definite leanings toward one kind of discipline or specialty, and respond variously to the same experiences, forming different personality traits. Ways of stimulating individual pupils to feel a group solidarity while at the same time to appreciate their own qualities are being studied. A related problem concerns the ways in which pupils link their shop or production work plans and routines together—following through on a job by controlling and checking the steps in its execution.

All of these problems, and other minor or tributary ones, have in recent years led to a sharp increase in educational research efforts and to some major reforms in educational practices. These measures are influencing the entire structure of Soviet schools, from preschool education to university programs. Textbooks are being rewritten, teaching methods are changing, curriculums are being radically revised, and the philosophy of education itself is in the process of being reformulated.

Signs of these fundamental changes have been many. Research projects and findings in the Russian Academy of Pedagogical Sciences in 1954–55 showed that work was proceeding along lines to transform the general educational school.[28] In 1956, a new Research Division for Contemporary Education and Schools Abroad (comparative education) was established in the Academy to study systematically foreign education.[29] One of their main current projects is studying programs of industrial-agricultural arts and practical training in schools abroad. During 1956–1958, Soviet educational research conducted a large program of experimental classes in combining theoretical, academic instruction with productive labor exercises in school shops and at industrial and agricultural enterprises.[30] Aiming to teach in more concrete ways the theoretical-scientific bases of industry and agriculture, to

[28] For example, see research reportings in *Izvestiia Akademii pedagogicheskikh nauk R.S.F.S.R.* (Journal of the Academy of Pedagogical Sciences of R.S.F.S.R.), Nos. 58 (1954), 73, and 75 (1955), especially No. 58.

[29] See, V. A. Veikshan, "The Moscow Center in Comparative Education," in *Comparative Education Review*, June 1959, pp. 4–5.

[30] A list of experimental schools in the Russian Federation is given in appendix III, p. 226.

lead students toward solving important problems involved in production training and work routines, and to reinforce data learned about theories and through abstract thinking, this extensive research has provided considerable guidance to Soviet educators in their efforts to reorganize education. In the main, their experience has shown that, in subjects like mathematics, physics, chemistry, and biology, students following the old curriculum with its traditional teaching methods received larger proportions of top marks on examinations than did those following the experimental curriculums with polytechnic-production education. Students in the experimental schools, however, were able as a result of their practical exercises and work to solve problems and use their knowledge considerably better than students of the regular program. Furthermore, the experimental students formed better habits, performed laboratory assignments better, used richer language in their expression, and had a fuller command of technical terms. Student interest in their school subjects and their relationships to the economy increased. Many pupils who before had unsatisfactory records in some subjects improved markedly under the new methods. In the course of these experiments, teachers, researchers, and students were able to solve many new problems connected with polytechnic education. Soviet educators consider their experimental work in this area to be a major success, although they admit that there are many difficult pedagogical and organizational questions, not to mention the problem of materials equipment, which yet have to be worked out.

It was obvious to us, when observing polytechnic classes, that real educative values can be and are taught in this program, and that Soviet educators have made an important breakthrough into new educational terrain. New methods, new principles, and perhaps a new philosophy of education are being worked out. At the same time, some matters in which the State has a direct interest are also involved. Teachers and school directors say that they agree by contract to produce in their school shops certain quantities of goods or hardware which will be used in some enterprise or institution. In the recently published words of the Russian Minister of Education E. I. Afanasenko, the program of the schools is intimately related to the major task facing the entire nation: "acceleration of the technical progress in industry and construction."[31] Soviet educators, he states, must accept this task as the

[31] E. Afanasenko, "K rabotnikam narodnogo obrazovaniia Rosiiskoi Federatsii", ("To workers of public education of the Russian Federation"), in *Narodnoe obrazovanie* (Public education), No. 9, 1959, p. 11.

"key to the successful fulfillment of the 7-year plan" and to implement the measures for bringing school work close to real life, a problem which is "directly and immediately connected with the task of an all-round development of technical progress in our country. . . ."

On the political side, the policy set by the XIX C.P.S.U. Congress was reiterated by the XX C.P.S.U. Congress in February 1956, which called for school reorganizations that would put more practical exercises into the program, preparing youngsters better for life situations. A resolution was passed demanding creation of polytechnic education.[32] This new policy was coincident with that of establishing universal secondary education in the urban and rural communities.

In their official statements and writings, Government leaders have come out strongly in favor of the reforms and have substantially pointed out the way they should go. Particularly outspoken on the matter has been Nikita S. Khrushchev, Prime Minister (Chairman) of the Soviet Council of Ministers and First Secretary of the C.P.S.U. Central Committee. At the XX C.P.S.U. Congress, his major report pointed to the need for bringing school activities closer to everyday living requirements. In a major address in April 1958 to the XIII Congress of the Komsomol, and then again in his proposals to the C.P.S.U. Presidium in September 1958,[33] Mr. Khrushchev urged ever more radical measures for reorganizing education. That he and the Government thought that some Soviet youth had the wrong idea about education was evident in his statement: "A portion of those who finish the 10-year school unwillingly go to work in factories, plants, and collective and state farms, and some even consider that it is an insult to them."[34]

A major Government document on the problem was issued on November 16, 1958, jointly by the C.P.S.U. Central Committee and the U.S.S.R. Council of Ministers.[35] Embodying essentially all the recommendations contained in the Khrushchev proposals, the new directives emphasized that the economic and cultural development of the country requires greater numbers of youth trained not only in academic subjects but also in the technical and vocational lines useful in a growing industrial society. These

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[32] *Direktivy XX S'ezda KPSS po shestomu piatiletnemu planu . . . na 1956–1960 gody.* (Directives of the XX Congress of the C.P.S.U. for the sixth five year plan . . . in 1956-1960.) Moscow. 1956. Pp. 56–57.

[33] *Izvestiia,* Sept. 21, 1958.

[34] *Idem.*

[35] *Izvestiia,* Nov. 16, 1958.

are practical considerations which the Government and educators have decided to pursue if the labor force is to be replenished and if productivity is to increase.

These various initiatives culminated in the passage of a law on education by the U.S.S.R. Supreme Soviet on December 24, 1958, entitled "Law on Strengthening the Ties of School with Life and on the Further Development of the System of Public Education in the U.S.S.R."[36] This measure incorporated, in the main, the Government's recommendations of November 1958. Further legislation and decrees by the Republic Governments of the Soviet Union have since supplemented the basic law.[37]

For the 1959–60 school year, new curriculums have been published which place the schools on a path that will, over a 5-year period, substantially recast their curricular structures and educational goals.[38] The original proposals of the Soviet Government, made first in September and then in November 1958, were insistent on engaging *all* young people aged 15 and 16 in productive labor upon their completing 8 years of basic education. An exception was to be made for the gifted and talented youth, especially in fields of science and arts. This strong emphasis by the Soviet leadership on adolescents' participation in industrial and agricultural labor left little doubt about the Government's intentions for secondary education: The majority of young people would acquire high school education through part-time study programs.

While the final measures enacted by the various legislatures do not require so large a shift away from full-time secondary education, they do envisage a substantial remaking of the Soviet school structure. Furthermore, the expansion in part-time schooling which is now under way and the increase of enrollments in part-time programs indicate a slight trend away from mass day education at the secondary level, as compared to trends up to about 1957. Part-time enrollments during 1957–1959, for example, increased by 20 percent (from 1 to 1.2 million). Taken together, the changes in Soviet general education rank in importance and scope with the reforms initiated during 1931–32 by the Soviet Government, which brought about the 7-year and 10-year general academic school systems.

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[36] *Izvestiia*, Dec. 25, 1958. An analysis of the law and its main features appears in *Soviet Commitment to Education*, pp. 126 ff.

[37] See, for example, the law passed by the R.S.F.S.R. Supreme Soviet, in *Izvestiia*, April 17, 1959.

[38] New curriculums issued by the R.S.F.S.R. Ministry of Education are published in appendix I.

MAIN FEATURES OF REFORMS

While it is beyond the scope of this study to examine and interpret fully the developments that have occurred (which most likely will continue to occur), it is useful to point out some of the more salient aspects and trends.

First of all, the general educational school has changed its name from "school of general education" to that of "labor-polytechnic school of general education." Secondly, the period of compulsory, free schooling has been raised from 7 years to 8. While this latter provision increases the national level of universal education in the Soviet Union, it also represents a change in the national educational policy announced at the XX C.P.S.U. Congress in February 1956. That Congress called for general 10-year education to be established in the main in all urban and rural communities. Soviet educational authorities maintain that secondary education will, however, continue to expand, and that enrollments will double by 1965 as compared with 1959. In this calculation, account should be made both for the recent drop in school enrollments due to low wartime and postwar birth rates, and for the coming increase in youngsters of high school age born during the latter part of the 1940's.

A third structural change is the addition of an 11th year to the secondary school, whereby the upper grades become 9, 10, and 11 instead of the former 8, 9, and 10. This development is especially interesting, because it lengthens the period of total schooling at a time when the numbers of youth of labor age are decreasing, and because it is accompanied by radical curriculum reforms. These two aspects of the school organization problem are closely related to each other and also to curriculum developments in the lower grades.

Examination of table 1 will help in understanding these relationships. Data on the concentrations of school hours in the four subject areas have been determined over the period from the 1955–56 school year to the 1959–60 school year, including planned curriculum changes announced by the Soviet Government for the R.S.F.S.R. These subject-area concentrations are: *Humanities*—mother tongue, foreign language, literature, history, civics, geography, drawing, singing, and music; *mathematics-sciences*—arithmetic, algebra, geometry, trigonometry, biology, chemistry, and physics; *polytechnic education*—manual arts, industrial and agricultural knowledge with practical exercises in shops and on plots, socially useful labor, and production work; and *physical education.* Based on official curriculums for each school year (see

Table 1.—Trends in curriculum concentrations (1956-1960)

Subject areas and grades	1956		1958			1960				
	Concentrations in subject areas during grade period		Concentrations in subject areas during grade period		Percent change from 1956	Subject areas and grades	Concentrations in subject areas during grade period		Percent change from	
	Hours	Percent	Hours	Percent			Hours	Percent	1956	1958
1	2	3	4	5	6	7	8	9	10	11
All subjects Grades 1–10	9,857	100	10,617	100	+7.7	All subjects 1–11 (planned)	12,679 (planned)	100	+28	+19.4
Humanities						*Humanities*				
Grades 1–10	5,049	53.0	5,100	48.1		Grades 1–11 (planned)	5,367 (planned)	42.3	+6.3	+5.2
Grades 5–10	3,089	46.7	3,058	42.2		Grades 6–11 planned)	2,759 (planned)	35.0	−10.6	−9.7
Math.-Sciences						*Math.-Sciences*				
Grades 1–10	3,300	33.0	3,332	31.3		Grades 1–11 (planned)	3,700 (planned)	29.2	+12.0	+11.0
Grades 5–10	2,442	36.8	2,447	33.8		Grades 6–11 (planned)	2,465 (planned)	31.0	+.95	+.74
Polytechnic						*Polytechnic*				
Grades 1–10	848	8.0	1,403	13.2		Grades 1–11 (planned)	2,820 (planned)	22.2	+232.0	+50.0
Grades 5–10	690	10.5	1,172	17.0		Grades 6–11 (planned)	2,220 (planned)	28.0	+222.0	+89.0
Physical Ed.						*Physical Ed.*				
Grades 1–10	660	6.0	782	7.4		Grades 1–11 (planned)	792 (planned)	6.3	+20.0	+1.3
Grades 5–10	396	6.0	510	7.0		Grades 6–11 (planned)	440 (planned)	6.0	+11.1	−13.7

NOTE.—For analytical purposes, the grade grouping used at the secondary school level of the 1960 curriculum (planned) was arbitrarily made to cover grades 6 through 11, rather than 5 through 11, so that equal numbers of years could be compared for the different curriculums. Slightly higher figures in total hours for subject concentrations would otherwise be reflected for 1960.

appendix I), these data reflect the total hours accumulated in each discipline or activity, and they are substantially indicative of major trends in curriculum developments in recent years as well as forecasts of planned changes.

In adding a school year to the old program, Soviet educators are increasing the total primary-secondary schooling by 19.4 percent over the 1957–58 curriculum (used in 50 percent of the Russian schools during the school year 1958–59), and by 28 percent over the 1955–56 curriculum in Russian schools. The distributions made of these increases over preceding curriculums have been uneven with respect to various subject and activity areas. Heavily favored in the redistributions have been programs in the practical, labor, and production courses and experiences. In terms of *relative* changes in concentrations, the academic subjects have actually *lost* weight in the overall, even though in absolute terms the total numbers of hours devoted to them in the new curriculum have increased somewhat. Thus, while 2,822 hours of instruction and training have been added to the entire primary-secondary school program between 1956 and 1960, which is a 28 percent increase, increases have been moderate indeed in the traditional subjects, only 318 hours are being added to social studies-humanities (increase of 6.3 percent), no more than 400 hours going to math-sciences (12 percent increase). In the polytechnic subjects, however, over 1,900 hours are being added in the new program (232 percent increase). Definitive analyses of curriculum changes must await examination of new programs of study and more class visits. It is well to point out too that changes in total class hours are not necessarily indicative of how much more or less education will be given under new programs and new methods.

These alterations in program, with the heavy shift toward practical skills and knowledge, can be largely explained by the construction of the curriculum in grades 9 through 11; two-thirds of the time in these grades will be taken up by class work, including some basic theory related to polytechnic training, while one-third of the time will be entirely devoted to work experience and work related programs of one kind or another. From grade 6 on, pupils will spend an average of almost 3 hours out of 10 in technical and production related training. Soviet educators told us that it is not wholly clear to them yet just how some of the production training programs will be structured and administered, since they are still experimenting with various possible solutions. Nonetheless, their plans are to bring all secondary

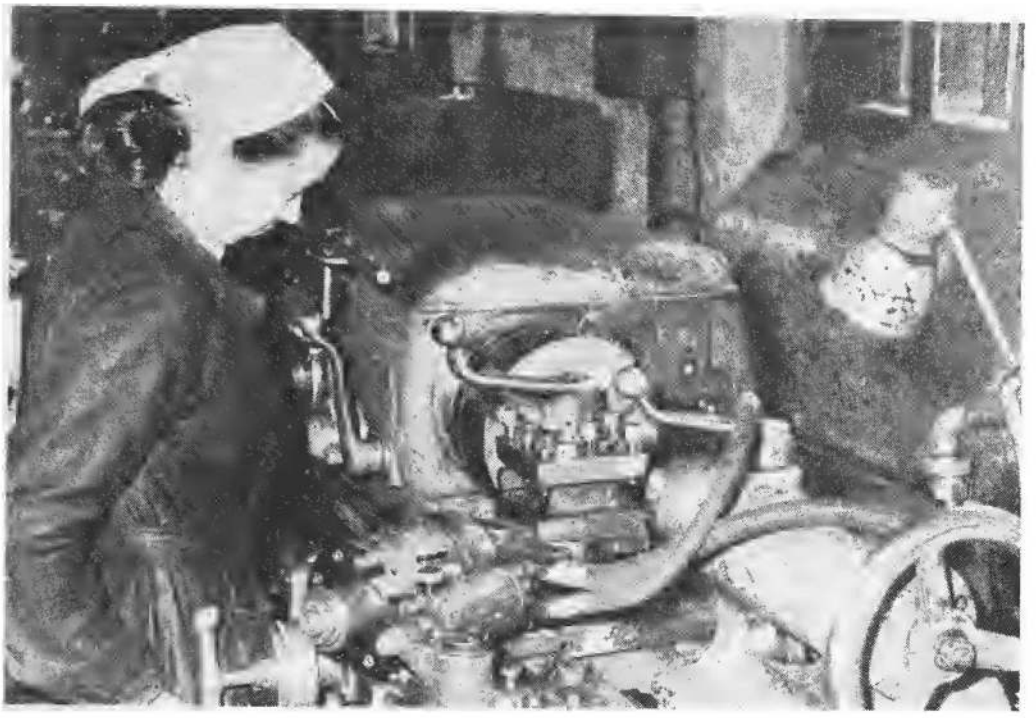

Figure 1-5.—Work experience program in 11-year school.

school children into labor education and training experiences through the regular school program. The dimensions of this undertaking promise to make the Soviet Polytechnic school one of the most industrially and technically oriented schools of general education among modern industrial societies.

It is our view that it is too early yet to draw any firm interpretations about these announced changes and about trends in school enrollments and practices. These changes will be taking place in stages over the 1959–1965 period, and at the same time Soviet education continues to experiment and to be subject to alteration by ministerial decree. During the 1959–60 school year, the vast majority of 10-year and 7-year schools will be following the curriculums that have been implemented since 1957. Children in grades 1-5, in grades 9-11 at many experimental schools, and in grade 8 in a large number of 7-year schools will be following new programs of study in the Russian Federation. According to official data available to us, it appears that during 1959–60, approximately 6 to 7 percent of the secondary schools in Russia are to be operating on an 11-year basis with new, experimental curriculums. At the same time, an 8th year of schooling will be introduced in approximately 3 percent of the 7-year Russian schools. Changes seem to be taking place on a similar scale in Ukraine. Our observations of Soviet schools'

progress in shifting to new curriculums suggest that the best equipped and staffed schools will be the ones to change their programs first.

Based on evidence thus far published, it appears that the polytechnic school with labor experience will provide both the academic and the prevocational (polytechnic) education with which Soviet youth will make their way in Soviet society. It also seems evident that the nature of the 8-year school and the absence of a requirement that children continue on to upper secondary school will provide strong tendencies toward making the 8-year school a terminal one for many youngsters. Future developments will indicate the actual trends, and meantime many problems admittedly lie ahead for Soviet educators.

We feel that, depending on pupil selection and on teacher preparation, the introduction of much more polytechnic and labor education might change the emphasis of the overall program in the academic disciplines. Such a change might occur especially if enrollments steadily increase and the new 11-year school becomes a unified, mass, and somewhat comprehensive educational institution. The vast majority of pupils will, upon graduation, take employment in the economy, while a small percentage will qualify for institutions of higher education and postsecondary schools. Up until the decade of the 1950's, these latter institutions absorbed most of the high school graduate. That Soviet educators are thinking about ways to provide future academic enrichment programs is evident in plans, which they discussed with us, to provide special after-school classes in mathematics and the sciences. Some experiments in academic "track" programs have also been taking place in a few secondary schools, and certain Soviet educators suggest introducing a multiple-program secondary school of a comprehensive type.[39] They also speak of an eventual 12-year program in order to accommodate all youth.

It seems clear to us that the Soviet Union, on a mass scale, is now adjusting its educational system so as to make a general education with polytechnic emphasis available to all youth in the decades ahead. The "reform measures" appear to respond to economic needs and technical development of the country, and to retain thus far an academic emphasis about the same as in the 10-year program. The exact character of these measures will be known, however, only as they are implemented in the schools and authoritatively reported on.

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[39] N. K. Goncharov, "O vvedenii furkatsii v starshikh klassakh srednei shkoly" ("On introducing multiple-track education in the senior grades of secondary school"), in *Sovetskaia pedagogika* (Soviet pedagogy), No. 6, 1958, p. 12 ff.

CHAPTER II

Science and Mathematics in the General Schools

IT SEEMS NATURAL that, by virture of the materialistic philosophy espoused by the Soviet Government, great emphasis should be placed on the natural sciences and mathematics. This view not only is reflected in the curriculums in institutions of education, but it also pervades the thinking of those who are in charge of educational programs.

Everywhere we visited we were impressed by the fact that the Soviet people are convinced that their destiny is closely linked with science and technology. They are proud of their successes with Sputniks and Luniks. They praise the accomplishments of such world-renowned scientists as Pavlov, Lobachevskii, and Mendeleev. They accord great respect and prestige to their large number of present-day scientists who are making names for themselves and pushing Soviet science and technology to the forefront. It was not surprising to us then that, when we interrogated pupils in the schools that we visited, a large percentage of them wanted to become scientists and engineers.

Some Fundamental Soviet Ideas

While in the U.S.S.R., we had opportunity to discuss with leading educators the role that science and mathematics education plays in the schools of the Soviet Union. We wanted to learn from them what their views are on how much science and mathematics should be taught in the schools and how these subjects should be taught.

In our consultations with officials of the Russian Soviet Federated Socialist Republic (R.S.F.S.R.) Ministry of Education in Moscow and in discussions with researchers and teachers around the country we questioned the educational policy of requiring

all pupils in the regular 10-year school to complete mathematics through solid geometry and trigonometry, physics up to topics in atomic physics, and chemistry up to topics in organic substances. We expressed the opinion that, although such subjects are appropriate for future scientists and engineers, other subjects could perhaps be studied more advantageously by students planning different types of careers. Our Soviet hosts replied that they believed their academic program currently in effect was absolutely necessary for *all* pupils if they were to become cultured citizens. They pointed out that science and mathematics constitute only a part of the curriculum, and that not only should each pupil know of Newton and Faraday and their work, for example, but equally should they know and appreciate the contributions of Shakespeare and Goethe.

It was emphasized that Soviet educators do not believe in science survey or general science courses. They feel that the pupil must learn the fundamentals of every field of knowledge, and that courses in "general science" were inadequate because they did not give the pupils a sufficient knowledge of the fundamentals. Soviet educators say they are not surprised that other countries following this kind of instruction complain about shortages of scientists and engineers. They assert that there is no shortage in the U.S.S.R. of students who desire and are prepared to make careers in science and engineering, and they attribute this circumstance to the basic scientific training they were getting in Soviet schools. It seems appropriate to point out that the planned Soviet economy enables Soviet officials to state that they experience no "shortages" of trained manpower, since quotas assigned for them are normally filled.

In chapter I, reference has been made to the parallel method of presenting subject matter. This practice is especially evident in the teaching of science and mathematics. Soviet educators believe that there should be close integration in the teaching of these subjects rather than the presentation of them as discrete, independent entities. Thus, physics, chemistry, and mathematics are taught in each of the grades 7 through 10, and the attempt is made to have the concepts taught in one subject reinforce the concepts taught in the other subjects. Systematic study of physics and chemistry with the aid of mathematics is introduced at appropriate levels.

Even in instruction in mathematics the parallel method of presentation is followed. Algebra, geometry, and trigonometry, for example, are each taught in the 9th and 10th grades. By this

Figure 2-1.—Tractor driving in 11th grade.

method Soviet educators believe that pupils will understand these branches of mathematics and their interrelations more thoroughly.

RELATION TO POLYTECHNIC TRAINING

While chapter III goes into detail on the present Soviet emphasis on polytechnic education, it is well to point out that this trend is reflected in the science and mathematics programs in the schools. Everywhere we went we were told that one of the chief aims was to link education closer to everyday life. To achieve this goal every effort is made to teach as early as possible understandings of scientific principles so that pupils can then relate them to the polytechnic training they will receive in the workshops, in the factories, and on the collective or state farms. In our visits to schools and factories we were shown numerous instances where pupils were attempting to put to practical use theoretical knowledge they had gained in the classroom.

BROAD ASPECTS OF THE CURRICULUM

The curriculum of the schools is prescribed for all grade levels and is essentially uniform throughout the U.S.S.R. Science and mathematics play significant roles in the total instructional pattern, occupying 31.4 percent of the student's time in the complete 10-year school. Science and mathematics are also taught

in the vocational schools and the technicums, but not as deeply or as far as in the complete 10-year school.

The percentage of time devoted to different areas of study in the complete 10-year school[1] follows:

Curricular Concentration, Grades 1 Through 10

	Percent
Humanities and social studies	48.0
Science and mathematics	31.4
Polytechnic education[1]	13.2
Physical education	7.4

[1] Includes technical drawing.

This breakdown of time devoted to various broad areas of study does not reveal the true importance given to science and mathematics because instruction in the elementary grades (1 through 4) is what might be called general or basic education, and the inclusion of these grades in the preceding computation tends to magnify the significance of the humanities and social sciences in the total curriculum. The following breakdown, using only grades 5 through 10, perhaps gives a more realistic picture of time allocation:

Curricular Concentration, Grades 5 Through 10

	Percent
Humanities and social studies	42.2
Science and mathematics	33.8
Polytechnic education[1]	17.0
Physical education	7.0

[1] Includes technical drawing.

Mathematics is regarded by Soviet educators as a very important subject. Of the total of 10,617 hours of instruction in the complete 10-year school, 2,023 hours, or 19.1 percent of the total time, is devoted to mathematics. Only Russian language and literature with 2,856 hours exceed the time given to mathematics instruction. Mathematics is taught 6 hours a week in every grade except the last half of grade 10, in which it is taught 5 hours a week.

Unlike schools in the United States, Soviet schools do not offer courses in chemistry, physics, and biology integrated into 1 year each. Instead they spread instruction in these subjects out over a number of years, beginning with biology in grade 4, physics in grade 6, and chemistry in grade 7. The number of hours devoted to these subjects at the various grade levels is shown in table 2. It is true, however, that much of the material taught in these

[1] Curriculum was that in effect prior to the changes announced in 1959. See appendix I, table B.

courses is taught in U.S. schools at equivalent grade levels under the title of science or general science.

The science and mathematics curriculums in detail including the number of hours devoted to each of the topics, are given in this chapter in the sections dealing with the teaching of biology, chemistry, mathematics, physics, and astronomy.

Table 2.—Science and mathematics curriculum in the general 10-year school[1]

(Two figures for 1 grade in a column indicate the number of hours for each half-year)

Name of subject	Number of hours a week in grade										Total hours	
	1	2	3	4	5	6	7	8	9	10	By the week	By the year
1	2	3	4	5	6	7	8	9	10	11	12	13
Mathematics	6	6	6	6	6	6	6	6	6	6/5	59.5	2,023
Biology	----	----	----	2	2	2	3	2	1	----	12	408
Physics	----	----	----	----	----	2	3	3	4/3	4	15.5	527
Astronomy	----	----	----	----	----	----	----	----	----	1	1	34
Chemistry	----	----	----	----	----	----	2	2	2	4	10	340

GENERAL TEACHING METHODS

The classes we observed were conducted almost exclusively by the lecture-recitation method. The teacher would discuss the lesson for the day and then call upon the pupils to recite, or to work out problems at the blackboard in front of the class, or to perform a demonstration. At the conclusion of his recitation or performance, the pupil would receive a mark which would be recorded in the teacher's record book and in the pupil's notebook as well. The marking system employed throughout the U.S.S.R. is 5 for excellent, 4 for good, 3 for passing, 2 for unsatisfactory, and 1 for failing. These marks are used universally, whether for a recitation, a quiz, a final examination, or for a final course grade.

Most of the science and mathematics classes that we visited had enrollments of between 20 to 30 pupils. In no classes or laboratories were there individual seats for pupils. Rather, the pupils sat in pairs or, in some instances, three at a desk. All work, even computations and sketches, had to be done in pen and ink by the pupils. Usually written work was very neat, but sometimes, if errors were made, it was quite messy since the errors could not easily be erased. The main purpose of requiring pen

[1] Curriculum plan in effect in 50 percent of the schools in the R.S.F.S.R. in 1958–59. For the complete curriculum, see appendix I, table B.

and ink, we were told, was to inculcate on the pupils habits of neatness and accuracy in their school work.

An atmosphere of strict discipline pervaded each classroom. The authority of the teacher seemed unquestioned, and the pupils seemed to strive to make favorable impressions by answering questions and otherwise performing as the teacher wanted them to. It is our impression that the classroom demeanor and the instructional methods used were generally uniform throughout the U.S.S.R.

Formalism and rote learning characterize Soviet classroom instruction for the most part. Undoubtedly this aspect of educational practice is fostered by the prescribed uniform curriculums and the desire on the part of teachers to see that their pupils master the assigned material and be able to pass the required final examinations, the content of which are likewise prescribed by official syllabuses. Since teachers are to a considerable extent judged by the performance of their pupils in these examinations, it is only natural for them to orient their instruction and teaching methods toward this goal. Under such circumstances a favorable climate for originality and initiative evidently does not exist.

Our observation of excessive formalism in Soviet instructional methods is supported by many Soviet educators themselves. In an article prepared for *The American Mathematical Monthly*, B. V. Gnedenko, professor of mathematics at the University of Kiev, writes:[2]

> Even now there is still a serious percentage of students to whom the spirit of mathematical thinking remains alien. Frequently, such pupils even learn the contents of the course fairly well, but their knowledge in this connection remains formal, and a comparatively insignificant change in the conditions of the problem lands them in serious difficulties. . . . Moreover, I think that there is a certain amount of formalism in exposition in some textbooks as well. Thus, for example, for the first five years a pupil is occupied with arithmetic and during these years an enormous number of problems are solved. . . . As a result, the students mechanically learn these rules and their thinking is not prepared for a conscious approach to each problem.

A further example of some dissatisfaction with science instruction is given in an article, "On the State of Physics Teaching in the Russian Republic," by G. P. Evronin of Moscow in *Fizika v Shkole* (Physics in the School):[3]

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[2] B. V. Gnedenko, "Mathematical Education in the U.S.S.R.," *The American Mathematical Monthly*, Vol. 64, No. 6 (Menasha, Wis., and Buffalo, N. Y.), June-July 1957, p. 393. (Translated by J. St. Clair-Sobell and W. H. Simons.)

[3] This quotation is taken from "On the State of Physics Teaching in the Russian Republic," *Science Education*, Vol. 43, No. 3 (Albany, N. Y.), April 1959, pp. 270–274, which is a translation by I. D. London from an article by G. P. Evronin in *Fizika v Shkole* (Physics in School), 1958, Vol. 18, No. 6, pp. 43–49.

> Problem solving is of great value in the teaching of physics, but there are teachers who misuse this activity and make of it a goal in itself, as they try to run through the solutions of all problems listed in the physics exercise book. Teachers frequently pay great attention to carrying out computational operations and fail to explain the physical meaning of a problem.
>
> When it comes to problem solving, students are frequently not encouraged to go at it on their own. Frequently, all they do is copy into their notebooks what is written on the board, at times even repeating mistakes committed there.

In conclusion Mr. Evronin states:

> The weak knowledge of physics with which our students graduate should disturb everyone. In the 1958–59 school year the teachers and leadership of the schools and of the organs of popular education shall have to strive for a radical change to the better in the teaching of physics and for a rise in the level of knowledge in this subject.

Soviet educational research has for several years been seeking ways to improve teaching methods in subjects such as physics and chemistry. The recent emphasis on polytechnic education has provided certain avenues of research in this direction, and the results appear to be encouraging. In a number of experimental schools, the combining of theory with practical work and applications of theory to real situations in industry and agriculture has reinforced the knowledge learned by pupils through other methods. For example, in the teaching of physics, results of the experimental programs were that pupils solved practical problems better, developed better habits, performed more efficiently in the laboratories, acquired richer language, and possessed a firmer command of technical terms than did pupils in the regular physics classes. At the same time, teachers and pupils in the experimental schools were able to solve a number of problems relating to the polytechnic education curriculum. Although the regular students achieved somewhat higher percentages of 5 marks, they failed to perform as well in the applications of knowledge as the experimental group.

A similar experience was recorded in regard to experimental classes in chemistry, where the industrial uses and applications of chemical substances were studied in practical ways. Although the students in regular classes received higher grades, those in the experimental schools reflected higher motivation and interest, and they understood better the relationships between theoretical knowledge and industrial techniques. The same kind of result came from experimental biology classes that used much field work and actual study of plants and animals in their natural conditions,

in addition to following a prescribed schedule of inside classwork and textbook assignments.

In our talks with Soviet educators, some of them readily acknowledged that traditional methods of teaching had neglected the relations between theory and practice and that improved teaching practices were now needed and being developed. This step appears to us to be also linked to the large enrollments in Soviet secondary schools in recent years.

QUIZZES AND EXAMINATIONS

Occasionally, written quizzes covering a few problems or questions are given by the teacher to the entire class. A quiz might require a part or the whole of an academic period. Since pupils always sit at least in pairs, parallel but different sets of questions are given. Examples of quizzes given in various subjects can be found in the sections dealing with the teaching of specific subjects.

At the end of each term a written course examination is given in each subject. These examinations extend over several days in order that pupils can prepare for them. At the end of the 7th and 10th years, comprehensive written and oral examinations are given, lasting over a period of 3 to 4 weeks. The passing of these examinations makes the pupil eligible for admission to the next higher level of education. These examinations are prepared locally in accordance with State manuals, specifying the topics to be covered and the kinds of questions to be asked.[4]

TEXTBOOKS

Textbooks at all grade levels in Soviet schools are purchased by the pupils. Since they are published by the Government in great quantities at cost and are printed on low-quality paper compared to American textbook standards, they are relatively inexpensive. The authors of the textbooks are Soviet educators who have won out in competition with others. In addition to prestige, considerable financial remuneration accrues to the successful author. An interesting aspect of most Soviet science and mathematics textbooks is that there are separate books for theory and separate books for problems and exercises.

ENRICHMENT PROGRAM

The requirements that all pupils follow a prescribed curriculum

[4] For a more complete discussion on examinations see W. K. Medlin and G. Myro, *Information on Education Around the World, No. 6*, Washington, U.S. Department of Health, Education, and Welfare, Office of Education, October 1958.

does not allow them during the regular school hours to explore and develop their special interests and abilities in specific subjects. However, these natural propensities are encouraged by means of an organized program of extra-curricular activities called "circles."

Each subject-matter teacher is expected to direct a "circle" or club activity in his or her subject specialty or related specialty during after-school hours at the school or Pioneer organization. For this work the teachers are paid hourly wages which are in addition to their regular salaries. Also, pupils may pursue their bents in the Pioneer Houses or Palaces which have been established to foster cultural, scientific, and physical activities of Communist youth. Trained leaders and teachers are employed in the Pioneer Palaces to direct the various programs which are conducted during after-school hours, evenings, and Sundays.

"Circles" in science and mathematics include such clubs as radio, aviation, chemistry, gardening, and mathematics. In School Number 204 in Moscow, for example, we were told the "chemistry circle" was working on special projects in qualitative and quantitative analysis. In another school we saw posted on the bulletin board in front of a mathematics class some difficult theorems and problems which were solved by members of the "mathematics circle."

A program which has done much in stimulating pupil interest in mathematics is that of the school Mathematical Olympiads. This activity was begun in 1934 by the University of Leningrad and has subsequently spread throughout the Soviet Union and, in some degree, to other countries. These Olympiads are written contests in the solution of problems that are more difficult than those ordinarily given in schools. These contests are held annually in most of the larger cities, and prizes and other suitable recognition, such as certificates, are given to the winners. The Olympiads assist to a considerable extent in the identification of mathematical talent. Many of the present outstanding Soviet mathematicians and professors in higher educational institutions are former Olympiad winners.[5]

A newly developed program is now underway, designed to stimulate interest in mathematics and to cover theory and problems over and above that given in the regular curriculum. Dr. A. N. Kolmogorov, an outstanding mathematician and a member of the U.S.S.R. Academy of Science, has urged that special classes

[5] An account of these Olympiads and some of the sample problems given in them appears in the article by B. V. Gnedenko, referred to in an earlier footnote of this chapter.

be organized after regular school hours. These classes are to meet one or two times a week over a period of 3 years. A program of this type, organized by interested teachers of the Pedagogical Institute and schools in the city of Ivanovo, a textile center, is now in operation. We were told by responsible Soviet educators that the University of Moscow will adopt this idea, and other institutions are likewise expected to do so. It is also hoped that this kind of program will spread to other disciplines.

Special schools for pupils gifted in dancing, music, and dramatics have existed for a long time in the Soviet Union and are well known. There apparently has been some consideration given to the establishment of schools for children who show special aptitudes for the sciences.[6] But in our talks with Soviet educators there was no evidence that there are immediate plans for them.

LABORATORIES, EQUIPMENT, AND FACILITIES

For the most part the science laboratories we saw had a dual function. They were used on some days as lecture rooms for theory purposes and on other days for laboratory work. Each desk, which was occupied by two or three students, was provided with electrical and gas outlets. In rural areas, spirit lamps were used rather than bunsen burners.

In advance of the meeting of the laboratory class, which always runs consecutively for two academic periods of 45 minutes each whereas lecture classes generally meet for one period at a time, the equipment would be placed on each pupil's desk by the teacher and the assistant. Almost every science teacher had an assistant whose duty was to assist with laboratory instruction and the care of equipment. The assistant would usually be a person who is planning to become a full-fledged teacher and who is currently enrolled in a pedagogical institute in evening study or by correspondence.

We asked Soviet educators about their seeming preference for the method of combination lecture-laboratory rooms as compared to the common practice in schools in the United States, in which pupils set up their own equipment in separate laboratory rooms. We were told that actually they prefer the separate classroom and the separate laboratory, but due to the shortage of school buildings brought about by war devastation and expanding enrollments, separate laboratory rooms were out of the question, generally speaking, at the present time.

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[6] Nikolai Nazarov, "Schooling for Future Scientists," *U.S.S.R.*, Jan. 1959, No. 1 (28), Embassy of the Union of Soviet Socialist Republics in the U.S.A., p. 37.

Adjoining each lecture-laboratory room was a preparation and stock room for the teacher and the assistant. At the schools we visited these rooms seemed to be amply stocked with the equipment and materials needed by the pupils. For example, there would be approximately 25 bottles of the reagent to be used, or a similar number of microscopes or voltmeters. Thus, each pupil in the class would be provided with the necessary equipment and materials to perform experiments, a number of which we observed. We did notice, however, that in the chemistry laboratories none of the students wore protective rubber aprons.

There also appeared to be available an ample supply of audio-visual aids—charts, models, specimens, projectors, etc. In some of the schools some pupils were trained to be projectionists. Almost every science room had pertinent wall charts hung on the walls and specimens and models on display in cabinets. In slide rule instruction, which is part of the curriculum in the regular 10-year school, each pupil is loaned a school-owned slide rule on which to learn and practice.

Although it seemed to us that in the schools we visited the facilities and equipment were generally adequate for effective science and mathematics instruction, apparently this situation is not true in all the schools of the Soviet Union. The article by G. P. Evronin previously referred to in the section on general teaching methods states:[7]

> The proper organization of physics teaching is rendered difficult in schools not having physics rooms. Altogether 19 percent of the schools in the Russian Republic are like that.
>
> In many schools, including those having separate physics rooms, the maintenance of apparatus is not satisfactorily handled, for example, in School No. 2 in Prokop'evsk (Director A. P. Kobzeva) . . . . . and in School No. 4 of Kemerovo (Director E. G. Ginzburg).
>
> In these schools pieces of apparatus in good repair are not, as a rule, separated from those out of commission; on the same shelf all kinds of devices are mixed up.

The Teaching of Biology

Like other subjects in the Soviet school curriculum, biology serves as a means of general education by acquainting pupils with the facts of the biological world in which they live. Also, the course in biology should provide a certain amount of technical training. The aims of the course are as follows:[8]

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[7] G. P. Evronin, *op. cit.*, p. 273.

[8] *Programmy srednei shkoly. Biologiia.* (Syllabi for secondary school. Biology.) Moscow, Uchpedgiz, 1958. Pp. 1 ff.

Figure 2-2.—Fifth grade biology pupils.

To give systematic, basic knowledge of the biological sciences.
To help in forming in pupils a materialistic outlook.
To reveal the harm of superstition and prejudice.
To acquaint pupils with the achievements of Soviet science in agrarian production.
To inculcate on the pupils practical knowledge by work in school laboratories, collective farms, and motor tractor stations.

The course of biology in the secondary school includes the following subjects: Botany, zoology, anatomy and physiology of man, and principles of Darwinism.

BOTANY

In the course in botany the pupils are taught the fundamentals of plant life and development. In grade 5 they study the structure and life of plants. They learn about seeds and sowing, growth of seeds, roots, nutrition of plants from the soil, and the formation of organic matter. They are taught the function of green leaves and the interrelation between green plants and living animal organisms. The fertilization and reproduction of plants are explained in an elementary way.

In a fifth grade class in biology the teacher, a graduate of a 2-year teacher training institution and currently enrolled in a third year program of teacher education by correspondence study, was explaining, by means of charts, the parts and composition

of blossoms and leaves. Flowers were distributed among the children, and they were asked to identify the parts and their functions. Pollinization was explained in the textbook and by the teacher.

In the sixth grade the botany course begins with a review of the work of the fifth grade. They then study such useful plants as potatoes, cabbages, wheat, corn, and flax. Each of these plants is analyzed from the point of morphology, and techniques of cultivating them are stressed. In studying potatoes and cabbages, pupils are taught the square planting method as well as methods of planting seedlings. The growth and reproduction of trees, particularly apple trees, are also studied in this grade.

In studying the characteristics and growing of wheat, pupils receive an elementary picture of various periods of plant growth in the light of the Lysenko theory. The pupils are asked to demonstrate vernalization in plants in the school plot or in the domestic environment. They study the peculiarities of corn and its importance to the national economy. They learn how the growth of corn has been made possible in the northern area of the U.S.S.R. The problem of mechanizing large-scale agricultural production is taken up. Excursions, slides, and movies are used to acquaint pupils with these processes.

On the development of new types of plants, the theory of I. V. Michurin is studied. According to the Soviet syllabus for this

Figure 2-3.—Sixth grade biology class, Leningrad.

grade, Michurin scientifically proved the possibility of remaking the nature of plants.

The school plot is widely used as a means of teaching practical knowledge of botany. Every school we visited had a school plot where plants and fruit trees were grown. During the growing season while school is in session, the pupils are required to spend several hours a week in labor work in the plot. During the summer months pupils are given definite assigned periods in which they are responsible for the care of the plot. Profits from the produce of the school plot are used in various ways for the benefit of the school and the pupils.

ZOOLOGY

The course in zoology (grade 7) gives an elementary picture of the historical evolution of the animal world. The pupils are taught how coordination of all the organs in animals is achieved by means of the nervous system. The teaching of Michurin and Pavlov are introduced in an elementary way. The study of animal life begins with the simplest forms and procedes to the complex ones. The great variation in the forms of life and their adaptability to the conditions of their environment are stressed.

The course commences with a study of one-celled animals, followed by hydra, worms, and mollusks. Insects are studied next. Besides learning about the structure and behaviour of insects, pupils learn about those which are harmful to agriculture and which are disseminators of disease, as well as those which are useful to mankind, such as bees.

Fish are studied next. Three or four samples of fish from fresh and salt water are studied according to the species selected by the teacher. In studying the various kinds of fish the pupils are taught how to safeguard and improve the fisheries in the U.S.S.R.

Although amphibians have little connection with the national economy, they are studied because of their great importance in the understanding of the animal world. The study of reptiles reveals the life of the vertebrae.

The unit on birds includes a broad range of material. For example, in the study of doves and other birds with which the pupils are acquainted, the likeness in the embryo stage to reptiles is pointed out. In the study of domestic birds, such as geese, ducks, and turkeys, the biological relationship of them to their wild ancestors is analyzed.

The unit on mammals discusses the characteristics of this most

highly developed form of animal. The pupils study the brain structure and reproduction of various kinds of mammals.

The course in zoology concludes with a picture of the historical evolution of the animal world and the influence of environment on the changing conditions of life on the earth. The problem of the origin of man is also treated briefly.

We visited a seventh grade class in zoology at a rural school south of Moscow. The lesson was on the comparative anatomies of man and monkey. A chart showing the anatomies of the two was on a stand in front of the classroom. The woman teacher lectured for awhile and then called upon several pupils to recite. We noted that the room seemed well provided with plants, charts, models, specimens, and other visual aids.

ANATOMY AND PHYSIOLOGY OF MAN

The course in anatomy and physiology of man is taught in grade 8. The purpose is to give pupils a knowledge of the human organism and basic information which will help to safeguard and strengthen health. In the process of this study the pupils become acquainted with the work of some of the Russian scientists. The contribution of the eminent scientist, Pavlov, is especially noted.

The first unit is on the bone and muscular system, followed by one on the organs of circulation and the influence of the nervous system on the heart and on the blood vessels. The next theme is organs of respiration. Here are also taken up problems of hygiene and ways of preventing disease carried through the air. Information on tuberculosis and its prevention is given.

The next topics treated are organs of digestion and metabolism. The importance of vitamins A, B, C, and D is stressed. In the study of the nervous system the pupils are informed about its structure and the roles of labor and rest in producing well-being and health.

While learning anatomy and physiology, pupils are required to dissect animal organs and study them by means of microscopes. They must know the bones of the skeleton and be able to point them out on their own bodies. They are also expected to know the functions and location of the lungs, heart, stomach, liver, and appendix and be able to take the pulse.

PRINCIPLES OF DARWINISM

This subject, which is given in grade 9, teaches about the origin of life together with the history of evolution in the organic

world, including the problem of the origin of man. The concept of evolution is the main theme of the course.

The first unit deals with organisms and their environments. The diversity of organisms and their adaptibility to environmental conditions is explained. This is followed by a section purporting to give proof of evolution. A comparison is made between the teachings of Darwin and the French naturalist J. Lamarque.

The third unit is divided into the following: Inheritance and variability; variations in cultivated plants and domestic animals; artificial selection; and the origin of species. Michurin's theory is included in the presentation of the evolutionary theory by Darwin. Also, attention is paid to the research work in hybridization by N. V. Tsitsina and the American naturalist Luther Burbank. The theoretical study is expected to be closely related to practice in plant growing and animal breeding.

The concluding theme of the course deals with the origin and evolution of life on earth. Engels' theory is treated, followed by an explanation of the hypothesis of A. P. Oparin, which treats the problem of the origin of life from a materialistic point of view. The origin of man is the final topic taken up.

Great importance is attached to the organization of naturalist work in the schools. It is the duty of the teacher to inculcate on pupils an understanding of, and love for, plants and animals, to awaken interest in the study of them and in the safeguarding of the natural resources and wealth of their native land.

METHODS USED TO STRENGTHEN KNOWLEDGE OF BIOLOGY

Mention has already been made of the new emphasis on polytechnic training in the schools of the Soviet Union, and the use of school plots to provide an opportunity for pupils to perform manual labor and also to gain practical first-hand knowledge with growing things.

In rural areas, where there is naturally strong emphasis on agriculture, excellent opportunities are available to develop projects which increase the knowledge and understanding of biological sciences. At the rural 11-year school in Gorki-Leninskie, near Moscow, this program has been well planned. At a short distance from the school there is an Institute of Genetics, a component of the Academy of Agricultural Sciences. Arrangements have been made whereby the school and its pupils assist the research workers of the Institute.

In the fourth grade pupils grow vegetables in the school plot, and in the fifth grade they grow soft and hard fruits as well. In

the sixth and seventh grades they grow corn for the Institute in a 6-acre plot. As well as tending the plot during the growing season when school is in regular session, the pupils work in shifts during the summer months for 18 days, 4 hours a day.

In the eighth grade the pupils receive theoretical instruction in plant growing. During the following summer they work in the fields of a nearby collective farm where 25 acres of land are reserved for their use. In addition, in May while they are still in the eighth grade and in September and October while they are in the ninth grade, they work 2 full days a week at this farm. During this period they grow barley, corn, cabbage, potatoes, and carrots.

In the ninth grade the pupils receive theoretical instruction in animal husbandry. In conjunction with this study there is practical study at a nearby livestock farm attached to the Institute of Genetics. The pattern of practical instruction with livestock is similar to that employed in the study of crops, the pupils completing this work in the fall during their 10th year. In the 10th and 11th years, since this is an experimental 11-year school, the pupils study the electrification and mechanization of agriculture. As well as learning how to operate tractors and combines, the pupils also learn about the care and repair of these machines, and they are required to give practical demonstrations of their knowledge.

At a city school in Moscow which we visited, a nature-study room is assigned to the seventh grade as a special project. In this room were an aquarium, birds, and such animals as rabbits, guinea pigs, and mice. The seventh grade pupils were divided into groups of 5 pupils who, in rotation, had responsibility for feeding and taking care of them. In this school and several other schools visited, pupils were required to water and look after the plants which were present everywhere.

At several of the schools children were working at projects involving the breeding and raising of rabbits. They built the cages and fences, fed the rabbits and took part in selling them. The money earned was used to defray the cost of various school activities, such as excursion trips.

BIOLOGY CURRICULUM

Following is a topical outline of the official curriculum with hours of instruction for biology taught in grades 5 through 9 in the regular 10-year school:[9]

[9] *Ibid.*, pp. 27 ff.

Figure 2-4.—"Socially useful work" at rural school. Building a rabbit pen.

Biology Curriculum, 10–Year School, Grades 5 to 9

BOTANY

Grade 5 (66 hrs.)

Introduction (1 hr.)

I. Plants in nature and in agricultural economy (4 hrs.)

II. Cellular structure of plants (3 hrs.)

III. Seed and sowing. Growing of seeds (14 hrs.)
Practical works and demonstration
Excursions

IV. Roots. Nutrition of plants from soil (10 hrs.)
Practical work and demonstration

V. Leaves. Formation in plants of organic substance (8 hrs.)
Practical work and demonstration

VI. Stems. Movement and deposition of substances in plants (9 hrs.)
Practical work and demonstration

VII. Reproduction of plants (14 hrs.)
Practical work and demonstration
Excursions

VIII. Plants. Live organisms (3 hrs.)
(Respiration, nutrition, growth, and reproduction)

Grade 6 (66 hrs.)

Review of the results of summer work (2 hrs.)

I. Cultivation of plants (9 hrs.)

II. Particular plants and their cultivation (21 hrs.)
   a. Potato (4 hrs.)
      Practical work and demonstration
   b. Cabbage (3 hrs.)
      Practical work and demonstration
   c. Wheat (4 hrs.)
      Practical work and demonstration
   d. Corn (4 hrs.)
      Practical work and demonstration
   e. Flax (2 hrs.)
      Practical work and demonstration
   f. Apple trees (4 hrs.)

III. Ripening of fruit (5 hrs.)
   Demonstration

IV. The basic group of plants (26 hrs.)
   a. Bacteria (4 hrs.)
   b. Algae (3 hrs.)
   c. Mushrooms (4 hrs.)
   d. Lichen (1 hr.)
   e. Moss (2 hrs.)
   f. Fern type of plants (3 hrs.)
   g. Gymnospermous plants (3 hrs.)
   h. Angiospermous plants (6 hrs.)

The study of these plants should be supported by demonstration, practical work, and necessary excursions in the spring, and visiting hothouses. The excursions are carried out during special allocated hours during the week.

V. General Picture of Evolution of Plants on Earth (3 hrs.)

ZOOLOGY

Grade 7 (99 hrs.)

The review of summer experiences (2 hrs.)

Introduction (1 hr.)

I. Simple animals (4 hrs.)

II. Coelenterata (intestinal) (3 hrs.)

III. Worms (6 hrs.)

IV. Mollusks (3 hrs.)

V. Arthropoda (16 hrs.)

VI. Vertebrates (47 hrs.)
   a. Fish (8 hrs.)
   b. Amphibians (5 hrs.)
   c. Reptiles (4 hrs.)
   d. Birds (15 hrs.)
   e. Mammals (15 hrs.)

This work must be supported by laboratory work, demonstrations, and excursions.

VII. Mammals in practical use in husbandry (11 hrs.)

VIII. Review (6 hrs.)

Anatomy and Physiology of Man

Grade 8 (66 hrs.)

Introduction (1 hr.)

I. General view of structure and functions of organisms (6 hrs.)

II. Bone and muscular system (7 hrs.)

III. Blood vessels and circulation of blood (9 hrs.)

IV. Organs of respiration (5 hrs.)

V. Digestive organs (8 hrs.)

VI. Metabolism (7 hrs.)

VII. Skin (3 hrs.)

VIII. Nervous system (17 hrs.)

IX. Development of organisms (2 hrs.)

Review (1 hr.)

Principles of Darwinism

Grade 9 (34 hrs.)

Introduction (1 hr.)

I. Organisms and environment
   a. Variations in organisms and their adaptability to conditions in their environments (1 hr.)
   b. Interrelation between organisms and conditions of environment (3 hrs.)

II. Evolutionary teaching of Darwin
   a. Development of historical outlook of nature (3 hrs.)
   b. The proof of evolution (3 hrs.)
   c. Inheritance and mutations (2 hrs.)
   d. Mutations of cultivated plants and domestic animals. Artificial selection (2 hrs.)
   e. Origin of species by way of natural selection (4 hrs.)

III. Michurin's teaching
   a. Heredity of organisms (4 hrs.)
   b. Theory of development of organisms by stages (1 hr.)
   c. Application of Michurin theory to husbandry (2 hrs.)

IV. Origin and evolution of life on earth
   a. Origin of life. Development of plant and animal life (3 hrs.)
   b. Origin of man (4 hrs.)

Review (1 hr.)

The Teaching of Chemistry

The aim of the chemistry program in the secondary school is to acquaint pupils with simple and systematic principles of chemistry; have them acquire chemical facts in accordance with the leading theories; develop in them the ability to observe and explain chemical phenomena which operate in nature and industry; and teach them habits of dealing with substances, chemical ware, and other laboratory apparatus.[10] According to the Soviet view, instruction in chemistry fosters a scientific, atheistic world view and educates in the spirit of Soviet patriotism.

Systematic study of chemistry, providing polytechnic instruction for future vocational applications, begins with grade 7 and continues through grade 10. The importance of chemistry to the national economy of the U.S.S.R. is stressed throughout the program, and in line with this objective at least one excursion must be conducted each year to a plant employing chemical processes.

GRADE 7

In this beginning course pupils become familiar with oxygen, hydrogen, air, water, oxidation, acids, bases, and salts. The teacher's explanation is usually followed by demonstrations and independent work in the laboratory. Theoretical information is given at such level that pupils can understand substances and their chemical transformations. They receive elementary information about types of chemical reactions, about atoms and molecules, and about the law of conservation of matter. They are expected to be able to read formulas and equations of reactions, use valence, write equations involving simple chemical reactions, and calculate the weight-relationships in these reactions.

The pupils become acquainted in this grade with the contributions of M. V. Lomonsov to the field of chemistry. They are expected to acquire the following knowledge and skills:

1. How to handle chemical substances, such as acids and alkalis. How to use test tubes, burners, retorts, and other kinds of laboratory equipment.
2. How to use weights and how to measure volumes of liquids.
3. How to dissolve chemical substances. How to filter, collect gases, and wash equipment.
4. How to identify oxygen, hydrogen, acids, and bases.
5. How to record observations and make drawings.

[10] R.S.F.S.R. Ministry of Education. *Programmy srednei shkoly. Khimiia.* (Syllabi for secondary school, Chemistry.) Moscow, Uchpedgiz, 1958. 24 p.

In a seventh grade chemistry class that we observed in session, the lesson was on the exchange of salts. The teacher placed on the board, one at a time, the chemical substances listed below. A pupil was called to the board and asked to write an equation of each reaction, showing the proper number of ions involved and the precipitate.

Exercise 1. Barium chloride and potassium sulfate.

Exercise 2. Lead nitrate and sodium chloride.

Exercise 3. Barium chloride and sulphuric acid.

GRADE 8

In the eighth grade, pupils review the theoretical material of the seventh grade and at the same time learn more about reactions and exchanges between acids, bases, and salts with the aid of concepts of the gram-atom and the gram-molecule. The three principal themes are: Alkali metals; halogens; oxygen and sulfur. All these themes have significance in training the pupils in the mastery of the periodic system of elements by D. I. Mendeleev.

In the eighth grade chemistry the pupils are expected to learn how to do the following:

1. To select the proper apparatus for a given problem.
2. To be able to purify chemical substances.
3. To be able to test for and recognize sulfuric acid, hydrochloric acid, and their salts.
4. To be able to produce desired chemical products, either directly or through intermediate steps.

GRADE 9

The chemistry in this grade commences with a systematic study of the periodic table of chemical elements and the structure of matter.

In the process of studying nitrogen and phosphorus the pupils become acquainted with ammonia, nitric acid, and nitrogenous and phosphate fertilizers, etc. In the study of carbon and silicon they learn about solid fuels and their derivatives and about industries processing materials containing silicon. As a result of instruction in these grades, pupils are expected to be able to do the following:

1. To be able to identify well-known compounds such as ammonia, nitric acid, and carbonic acid.
2. To identify and understand fertilizers.

3. To conduct simple chemical experiments involving the elements studied in this grade.

At a 10-year school in the Georgian S.S.R., we observed a ninth-grade class consisting of about 25 pupils. The members of the class first performed an experiment of producing ammonia gas by placing a piece of calcite in a solution of ammonium chloride. In addition to the pupils performing the experiment at their desks, one pupil performed the experiment in front of the class. The pupils were asked to identify the gas produced by its odor. Then the pupil giving the demonstration in front of the class was asked to write a properly balanced equation of the chemical reaction on a small portable blackboard as there were no permanent wall blackboards in this classroom. This chemistry classroom was less well equipped than some of the chemistry classrooms in urban areas we visited. Spirit lamps were used instead of bunsen burners. A small demonstration table and a periodic wall chart were the only evidences that this was a chemistry room.

After the experiment had been performed and the chemical equation checked out, the remainder of the period was spent in balancing equations of other chemical reactions. The teacher gave the reacting substances, and a pupil was called to the front of the room to write a balanced equation. The teacher would assist when necessary and also call upon other pupils for help. Pupils at desks wrote down in their notebooks the steps as they were completed. The teacher of the class was a middle-aged woman who wore a white smock and who was a graduate of Tbilisi State University. She had a woman assistant who was in training to be a teacher.

GRADE 10

The program in the 10th grade consists of a study of metals, Avagadro's Law and its applications, and organic substances. The pupils are taught the physical and chemical properties of various metals and alloys. The alkali metals, alkaline-earth metals, aluminum, and iron are studied.

In the unit on organic matters the pupils learn about the hydrocarbons and other basic organic compounds. Comparisons are made between organic and inorganic substances. Fundamental to the study of organic chemistry is the theory of A. M. Butlerov. A new topic being introduced in the 1950–60 academic year is synthetic high-molecular compounds to which 10 periods will be devoted.

We visited a 10th grade chemistry class at an experimental school in Moscow. This class of about 25 pupils, of whom only 5 were boys, was reviewing for its final examination in chemistry. Pupils were required to go to the front of the class and write chemical substances in ionic form, showing the proper valences. They were then asked to combine substances and write a balanced equation, indicating the precipitates, if any. One of the examples worked out during the class was the reaction of aluminum sulfate and barium nitrate. Pupils were also required to explain the basis for arrangement of chemical elements. On the walls around the room were charts showing the industrial uses of various chemical compounds. The teacher of this class was a young woman who apparently knew her subject and appeared to be an effective teacher.

SOME EXAMPLES OF QUIZZES IN CHEMISTRY

During our visits to schools we obtained samples of quizzes which had been given during the year. Following are some of the quizzes which were given and which serve to show the level of work required in various grades:

A Seventh-Grade Quiz (Given in April 1959)

1. What do we call a salt? Give definition, write the formulas of three salts, and name them.
2. Determine the percentage of copper and oxygen in cupric oxide.
3. What is a gram-atom? How many gram-atoms of oxygen are contained in a gram-molecule of carbon dioxide?
4. How many grams of hydrogen are produced by the action of sulfuric acid on 0.5 grams of zinc?

An Eighth Grade Quiz (Variation No. 5)

1. Which reactions are classed as exothermic and which endothermic? Give an example of each type of reaction.
2. Write the following formulas:
   a. Zinc sulfide
   b. Zinc sulfite
   c. Zinc sulfate
3. What regent is used to test for sulfuric acid and its salts?
4. State the rule for dissolving sulfuric acid in water.
5. What weight of phosphorus will be necessary in order to obtain 142 grams of phosphorus anhydride. The atomic weight of phosphorus is 31.

A Ninth Grade Quiz (Given in January 1959)

1. Judging from the location of chromium in the Mendeleev periodic table, write the formula of chromic anhydride and of chromic acid.

2. What is the difference between short periods and long periods, and on what principle is each long period subdivided into rows in the Mendeleev periodic table?
3. Write the equation for the reaction between the following substances:
   a. Cesium oxide and hydrobromic acid.
   b. Strontium hydroxide and nitrous acid.
   c. Hydrogen sulfide and calcium hydroxide.
4. In the Mendeleev periodic system what place is occupied by arsenic? Describe the properties of arsenic. Is it metallic or nonmetallic, and how does it combine with oxygen and hydrogen?

A Ninth Grade Quiz (Given in April 1959)

1. Ammonia was passed through 200 grams of a 10 percent solution of nitric acid. What salt and how much of it was formed in the solution if the amount of ammonia used is assumed to be in excess?
2. How is ammonia converted to ammonium sulfate?
3. Briefly describe the properties of ammonium hydroxide. Write an equation to illustrate each chemical property listed, and in each case state the conditions under which the reaction will occur.
4. Write complete abridged, ionic equations for reactions between the following reagents:
   a. Calcium hydroxide and nitric acid.
   b. Ammonium nitrate and caustic soda.

A 10 Grade Quiz (Given in March 1959. Time allowed—45 minutes)

1. Write equations for a series of reactions by which methyl formate would be prepared, beginning with methane.
2. Describe the characteristic reactions of glucose.
3. How would you prepare barium sulfate by an exchange reaction? Calculate the necessary weights of the initial compounds for the preparation of 4.66 grams of barium sulfate.
4. Which reactions are called hydrolysis?

CHEMISTRY CURRICULUM

Following is a topical outline of the official curriculum with hours of instruction for chemistry which is taught in grades 7 through 10 in the regular 10-year school:[11]

Chemistry Curriculum, 10-Year School, Grades 7 to 10

Grade 7 (66 hrs.)

1. Substances and their transmutations (8 hrs.)
2. Atoms, chemical elements. Principles and laws of chemistry (14 hrs.)
3. Oxygen. Air. Combustion (8 hrs.)
4. Hydrogen. Water. Valence (15 hrs.)

[11] *Ibid.*, pp. 13 ff.

5. Oxidation, acids, bases, and salts (21 hrs.)
6. Excursions: water-purification station, oxygen plant, mechanical shop, calcining furnace, etc.

Grade 8 (66 hrs.)

Review of seventh grade material (21 hrs., of which 4 are for practical work): (1) interaction of acids, bases, and salts among themselves, and (2) experimental problems on oxidation, acids, bases, and salts.

1. Alkali metals (sodium and potassium) (4 hrs.)
2. Halogens (18 hrs., of which 4 are for practical work)
3. Oxygen and sulfur (23 hrs., of which 3 are for practical work)

Grade 9 (99 hrs.)

Review of eighth grade work (6 hrs.) [12]

1. Periodic law and periodic table of chemical elements of D. I. Mendeleev. Structure of matter (26 hrs.)
2. Nitrogen and phosphorus (40 hrs., of which 9 for practical work)
3. Carbon and silicon [13] (27 hrs., of which 4 for practical work)

Grade 10 (116 hrs.)

1. Metals (40 hrs.)
   General properties of metals (6 hrs.)
   Alkali metals (4 hrs.)
   Alkaline-earth metals (6 hrs.)
   Aluminum (6 hrs.)
   Iron (10 hrs.)
   Practical exercises (8 hrs.)
2. Avogadro's Law and its application in chemistry (6 hrs.)
3. Organic substances (54 hrs.)
   Basic data on organic and inorganic substances (2 hrs.)
   Hydrocarbons (18 hrs.)
   Oxygen-containing organic compounds (18 hrs.)
   Nitrogen-containing organic compounds (6 hrs.)
   Practical exercises (10 hrs.)
4. Preparation for examination (16 hrs.) [14]

The Teaching of Mathematics

The purpose of mathematics instruction in the Soviet general school is to impart to pupils a definite body of knowledge useful for understanding numerical relations of simple situations in the

[12] Schools operating on new 1958-59 curriculum are not obliged to do the review.
[13] Schools on new curriculum will offer this in grade 10, devoting 20 hours less to its study.
[14] Sixteen hours are devoted for review and preparation for the final examination.

real world and for investigating spatial forms.[15] This knowledge should give to pupils a clear impression of mathematics as a systematic discipline and thus prepare them to study more advanced mathematical topics and related subjects. In the process of studying mathematics, pupils are expected to test their knowledge and prove results through application of methods of scientific proof and control. Some Soviet mathematics educators suggest that pupils should develop skill in organizing and conducting simple mathematical research. The study of mathematics should also assist in developing grammatical competence and precision and brevity of expression.

Included in the body of knowledge deemed to be of general value are the following concepts, skills, and abilities:

1. An ability to carry out arithmetic operations with whole numbers and fractions.
2. A familiarity with systems of measurement.
3. A familiarity with simple geometric forms.
4. A familiarity with various methods of visual representation of quantitative relationships (graphs, diagrams, etc.).

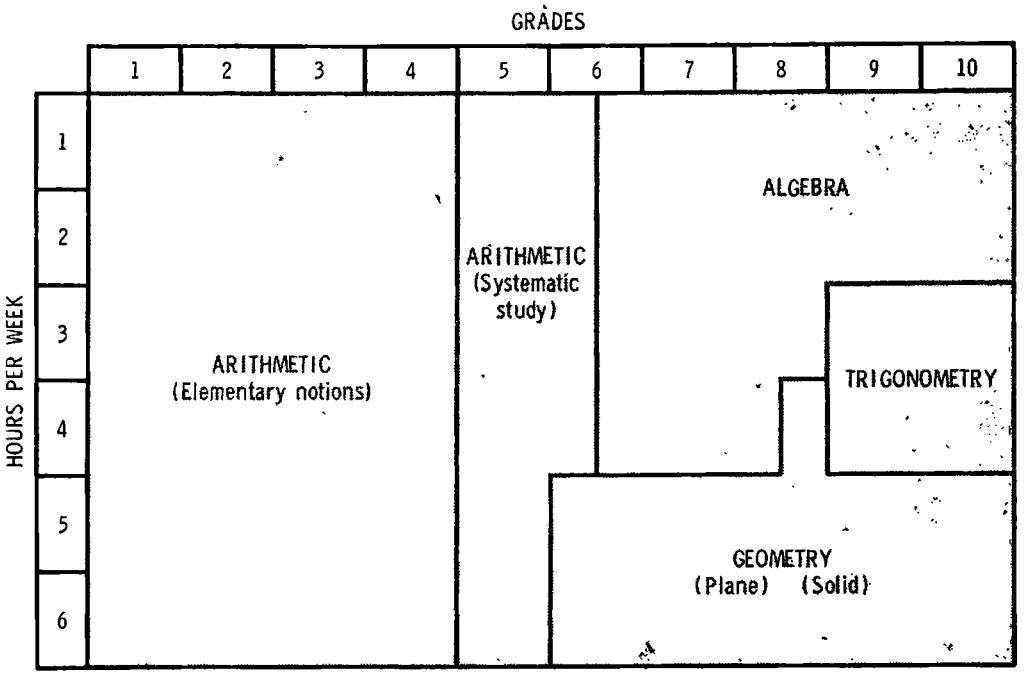
POLYTECHNIC EMPHASIS

The recent Soviet emphasis in polytechnic education has resulted in increased efforts in relating mathematics to problems connected with practical life and fundamentals of production. To achieve this goal, mathematics teachers in recent years have been urged to emphasize topics which contribute to a better understanding of polytechnic education. Specific mathematical topics considered to be of polytechnic value include:

1. Approximate computation
2. The use of simple calculating machines and devices
3. The construction and use of tables
4. Functions and graphs
5. Approximate and graphical solution of problems
6. Field measurements
7. Drawing and the use of drawing instruments
8. Accuracy and precision
9. Rounding off of numbers
10. Measurement of inaccessible distances

[15] In preparing this section use has been made of some materials contained in the doctoral thesis, *The Mathematics Program of the Soviet Secondary School: Its Status and Innovations*, submitted by Bruce R. Vogeli to the University of Michigan in 1959, 547 pp. For an extended treatment of mathematics taught in the Soviet Union, see Vogeli's thesis.

Mathematics curriculum in the 10-year school



According to the official mathematics syllabus for the academic year 1957–58, teachers of mathematics are expected to give particular attention to the understanding of fundamental ideas, especially the concept of a function and its graphical description.[16] The study of simple functions and their graphical interpretations begins as early as the fifth grade. The historical development and cultural value of mathematics are to be taught, and the contributions of such outstanding mathematicians as Euclid, Archimedes, Descartes, Euler, Gauss, and Lobachevskii are to be noted.

PARALLEL PRESENTATION OF SUBJECT MATTER

Reference has already been made to the Soviet practice of teaching a number of related subjects in the same grade with the aim that such presentation will contribute to a better understanding of the interrelationships between them. In mathematics, this approach is achieved by teaching arithmetic and geometry in the first half of the 6th grade and algebra and geometry in the last half of this grade; algebra and geometry in the 7th and 8th grades; and algebra, geometry and trigonometry in the 9th and 10th grades. The parallel treatment of mathematics subjects is illustrated graphically in the chart above.

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[16] *Programmy srednei shkoly na 1957–58 uchebnyi god. Matematika.* (Syllabi for secondary school for the 1957–58 school year. Mathematics.) Moscow, Uchpedgiz, 1957. 44 p.

ARITHMETIC

In grades 1 through 4 pupils study the elementary notions of the arithmetic of numbers, and they develop skills in simple calculations and measurements. In grade 1 they are taught numeration and simple arithmetic operations with whole numbers. In grades 2 and 3 they build upon and extend these concepts. In grade 4 they are taught composite denominate numbers and simple fractions. They also learn addition and subtraction on the abacus, which is used extensively throughout the U.S.S.R. in commercial establishments in lieu of adding machines. Practice on the abacus strengthens pupils' understanding of number concepts.

In the fifth grade and the first half of the sixth grade pupils complete the study of arithmetic. They learn about combined operations, divisibility of numbers, operations with fractions, decimals, percent, ratios, and proportion. The study of decimals follows that of fractions, and the fact that decimals are special kinds of fractions is pointed out.

In the fifth grade 6 hours of practical work are required. This practical instruction includes such tasks as:

1. The marking of points and the laying out of lines in the field.
2. Measurement of distances in the field with measuring tapes, field compasses, and by paces.
3. Visual estimation of distance.
4. Use of the cross staff.
5. The laying out of a rectangular plot and the calculation of its area.
6. The calculation of the area of plots of land having the form of quadrilaterals.

At a school in Kiev we observed a fifth grade class of about 20 pupils performing measurements on the school playground under the supervision of their teacher.

In our visit to a boarding school in Moscow, we sat in on a fifth grade arithmetic class. The following three exercises consumed most of the 45-minute period:

Exercise 1. Find x if $0.7x = 17.5$

Exercise 2. Find the value of $4\frac{1}{2} \times [8\frac{3}{5} \times \frac{1}{4} - (2\frac{61}{90} - 1\frac{1}{12})]$

Exercise 3. Find the value of

$$\left[\frac{(1.25 \div 3.75 + 4\frac{4}{9} \div 3\frac{1}{3}) \div 1\frac{1}{9}}{\frac{5}{18} + \frac{4}{15} - 0.35}\right] \div 13.5$$

Pupils were called to the front blackboard to work out each exercise. In case of exercises 2 and 3, the pupil who commenced

the problem was replaced in turn by other pupils who continued the solution of the problem from the point at which the previous pupil stopped. Systematic, step-by-step solution of the problem, involving working out component parts and substituting their values, was strongly emphasized. Pupils at their seats were required simultaneously to work out these same exercises in their notebooks. The teacher of this class was a man with 7 years of teaching experience. He had graduated from a 2-year pedagogical school, majoring in physics, and was presently enrolled as a 5th-year student in a pedagogical institute and majoring in mathematics.

In a fifth grade arithmetic class in Zagorsk, we observed arithmetic exercises being worked in class similar to that just discussed. In one of the pupil's notebooks, under the date of February 18, 1959, we noted the following two problems with their solutions:

Find the unknown quantity:

Exercise 1. $9\frac{5}{12} + x = 12\frac{7}{8}$

Exercise 2. $\frac{8}{15} - x = \frac{7}{30}$

ALGEBRA

The purpose of algebra is to teach the pupils how to generalize the processes of arithmetic, how to solve algebraic equations with ease and understanding, and how to apply this knowledge in solving problems in allied disciplines such as chemistry and physics.

The teaching of algebra begins in the second semester of grade 6 and continues through grade 10. Topics covered during the study of algebra include solution of equations of first, second, and higher degree; systems of simultaneous equations; factorization of polynomials; roots and powers; limits and progressions; exponents and logarithms; permutations and combinations; complex numbers; and inequalities. The theory and use of the slide rule is taught in grade 9.

At an eighth grade class in algebra in Moscow, the following problems were assigned to the pupils for homework:

Exercise 1.—A bus left City A for City B, which are 150 kilometers apart. Three hours after the bus left City A, it had to stop for 20 minutes. During the remainder of the trip the bus went 6 kilometers per hour faster than it did during the first 3 hours, and it thereby arrived at City B at the same time it would have if it traveled all the way at its initial speed without stopping. Find the initial speed of the bus.

Exercise 2. Solve each of the following systems of equations:

$$\begin{cases} \dfrac{x^2+xy+y^2}{xy}=\dfrac{7}{2} \\ x-6+y=0 \end{cases} \quad \text{and} \quad \begin{cases} x^2+y^2=34 \\ xy=15 \end{cases}$$

Exercise 3. Find the value of:

$$\{[0.84+(1\tfrac{8}{39}-4\tfrac{1}{52})\times 4.8-1.2\div 3.75]\div 2\tfrac{38}{65}+\tfrac{3}{20}\}\times(6.4\times 1.35-0.64)$$

At a secondary school in Kiev the following two problems were given to be worked out by the pupils during the class period:

Exercise 1. Solve the following system of equations:

$$\begin{cases} \dfrac{x}{y}+\dfrac{y}{x}=\dfrac{34}{15} \\ x^2+y^2=34 \end{cases}$$

Exercise 2. Write the equation having roots:

$$x_1=\frac{5}{4+\sqrt{6}} \text{ and } x_2=\frac{5}{4-\sqrt{6}}$$

At the end of the class period this class was assigned the following problems for homework:

Exercise 1. Simplify the expression

$$\left(\frac{-1}{\sqrt{1-n}}+\sqrt{1+n}\right)\times\frac{1+\sqrt{1-n^2}}{\sqrt{1+n}}$$

Exercise 2. Solve the following systems of equations:

$$\begin{cases} x-y=2 \\ \dfrac{1}{x}-\dfrac{1}{y}=-\dfrac{1}{12} \end{cases} \quad \text{and} \quad \begin{cases} \sqrt{x}+\sqrt{y}=5 \\ \sqrt{xy}=6 \end{cases}$$

The teacher of this class had graduated in 1932 under a 4-year program in the Faculty of Mathematics at Kiev State University and has been a mathematics teacher in the schools since that time.

GEOMETRY

The purpose of teaching geometry in the secondary school is to give the pupils a systematic study of geometric figures in the plane and in space and to develop logical thinking, spatial imagination, and ability to apply this knowledge to practical situations. The practical work consists of measurement of lengths and plane areas and the determination of surface areas and volumes of solids, both those encountered in technology and those in practical daily living.

The study of geometry commences in grade 6 and continues through grade 10. In grade 6 are studied elementary notions, such as fundamental concepts, parallelism, and triangles, continuing with quadrilaterals and circles in grade 7. In grade 8,

pupils study ratios and proportions of segments, similar figures, and areas of polygons. In grade 9 regular polygons are taken up, followed by the metric properties of the circle. About two-thirds of study time in geometry in this grade is devoted to solid geometry, the study of which is likewise continued during the entire 10th grade.

Outside of Moscow in a rural school we visited an eighth-grade class in plane geometry which was being conducted in the electrotechnic laboratory room. The pupils were working on problems relating to the areas of polygons. In a 10th grade class in solid geometry in a school in Moscow the pupils were reviewing in preparation for their final examinations. Pupils were called by the teacher to the front blackboard, one at a time, to carry out steps in the solution of several problems concerning the inscription of geometric solids within other geometric solids. At the conclusion of the recitation three homework problems were assigned.

In another school we were shown a mathematics classroom in which no class was meeting at the time. A large slide rule was hung on the wall in the front of the classroom. A number of mathematics charts and geometric models were prominently displayed. There was a transit in the back of the room as well as some pupil-made measuring instruments.

TRIGONOMETRY

The purpose of teaching trigonometry in the Soviet schools is to give pupils essential information pertaining to trigonometric functions, solution of triangles, and the application of trigonometry in the solution of problems related to geometry, physics, and technology.

Trigonometry is taught in grades 9 and 10. In grade 9 are studied the trigonometric functions of an arbitrary angle, relations between trigonometric functions, and functions of composite angles, and in grade 10, solution of oblique triangles, inverse trigonometric functions, and trigonometric equations.

MATHEMATICS CURRICULUM

Following is a topical outline of the official curriculum with hours of instruction for mathematics taught in grades 5 through 10, inclusive, in the regular 10-year school:[17]

[17] *Ibid.*, pp. 25 ff.

Mathematics Curriculum, 10-Year School, grades 5 to 10

Grade 5

ARITHMETIC

(6 hrs. per week, total 198 hrs.)

1. Whole numbers (20 hrs. classwork; 8 hrs. homework)
2. Division of numbers (20 hrs. classwork; 8 hrs. homework)
3. Simple fractions (90 hrs. classwork; 36 hrs. homework)
4. Decimals (50 hrs. classwork; 20 hrs. homework)
5. Practical applications (6 hrs. classwork). The students and teacher will will use area near the school for measuring the distances with use of tape and by steps. They are taught to measure distances by eye, make angular measurements, and calculate areas.
6. Review (12 hrs. classwork; 6 hrs. homework)

Grade 6

(6 hrs. per week, total 198 hrs.)

ARITHMETIC

(4 hrs. per week in the first semester; total 66 hrs.)

1. Percent (20 hrs. classwork; 10 hrs. homework)
2. Proportion (32 hrs. classwork; 16 hrs. homework)
3. Review (14 hrs. classwork; 7 hrs. homework)

ALGEBRA

(4 hrs. per week in the second semester; total 66 hrs.)

1. Algebraic expressions; equations (16 hrs. classwork; 8 hrs. homework)
2. Positive and negative numbers (20 hrs. classwork; 10 hrs. homework)
3. Operations on integral algebraic expressions (30 hrs. classwork; 15 hrs. homework)

GEOMETRY

(2 hrs. per week; total 66 hrs.)

1. Fundamental concepts (14 hrs. classwork; 7 hrs. homework)
2. Parallelism (16 hrs. classwork; 8 hrs. homework)
3. Triangles (32 hrs. classwork; 16 hrs. homework)
4. Practical study (4 hrs.)

   The practical work consists of measurement of angles by eye, drawing parallel lines, and elementary surveying.

Grade 7

(6 hrs. per week; total 198 hrs.)

ALGEBRA

(4 hrs. per week; total 132 hrs.)

1. Factorization of polynomials (36 hrs. classwork; 18 hrs. homework)

2. Algebraic fractions (24 hrs. of classwork; 12 hrs. homework)
3. Equations of first degree with one unknown (34 hrs. classwork; 17 hrs. homework)
4. Systems of equations with two unknowns (28 hrs. classwork; 14 hrs. homework)
5. Review (10 hrs. classwork; 5 hrs. homework)

GEOMETRY

(2 hrs. per week; total 66 hrs.)

1. Quadrilaterals (26 hrs. classwork; 13 hrs. homework)
2. Circles (34 hrs. classwork; 17 hrs. homework)
3. Practical study (6 hrs.).

Grade 8

(6 hrs. per week; total 198 hrs.)

ALGEBRA

(4 hrs. per week first semester; 3 hrs. second semester, total 116 hrs.)

1. Powers and roots (44 hrs. classwork; 22 hrs. homework)
2. Equations of second degrees (42 hrs. classwork; 21 hrs. homework)
3. Functions and graphs (12 hrs. classwork; 6 hrs. homework)
4. Systems of quadratic equations with two unknowns (18 hrs. classwork; 9 hrs. homework)

GEOMETRY

(2 hrs. per week in first semester; 3 hrs, second semester, total 82 hrs.)

1. Ratios and proportions of segments (10 hrs. classwork; 5 hrs. homework)
2. Homotheticity and similarity (18 hrs. classwork; 9 hrs. homework)
3. Metric relations in triangles and circles (36 hrs. classwork; 18 hrs. homework)
4. Measurement of the areas of polygons (14 hrs. classwork; 7 hrs. homework)
5. Practical study (4 hrs.)

Grade 9

(6 hrs. per week; total 198 hrs.)

ALGEBRA

(2 hrs. per week; total 66 hrs.)

1. Limits (6 hrs. classwork; 3 hrs. homework)
2. Progressions (14 hrs. classwork; 7 hrs. homework)
3. Exponential and logarithmic functions (40 hrs. classwork; 20 hrs. homework)
4. Practical work in using the slide rule (6 hrs.)

GEOMETRY

(2 hrs. per week; total 66 hrs.)

1. Regular polygons (12 hrs. classwork; 6 hrs. homework)
2. The length of circumference and the area of a circle (10 hrs. classwork; 5 hrs. homework)
3. Solid geometry (40 hrs. classwork; 20 hrs. homework)
4. Practical study (4 hrs.)

TRIGONOMETRY

(2 hrs. per week; total 66 hrs.)

1. Trigonometric functions of an arbitrary angle (10 hrs. classwork; 5 hrs. homework)
2. Algebraic relations between trigonometric functions of the same angle. Formulas of reduction (16 hrs. classwork; 8 hrs. homework)
3. Trigonometric functions of a numerical argument (16 hrs. classwork; 8 hrs. homework)
4. Addition theorems (24 hrs. classwork; 12 hrs. homework)

Grade 10

(6 hrs. per week; total 198 hrs.)[18]

ALGEBRA

(2 hrs. per week; total 66 hrs.)

1. Permutations and the binomial theorem (12 hrs. classwork; 6 hrs. homework)
2. Complex numbers (12 hrs. classwork; 6 hrs. homework)
3. Inequalities (22 hrs. classwork; 11 hrs. homework)
4. Equations of higher degree (12 hrs. classwork; 6 hrs. homework)
5. Review (8 hrs. classwork; 4 hrs. homework)

GEOMETRY

(2 hrs. per week; total 66 hrs.)

1. Polyhedra (28 hrs. classwork; 14 hrs. homework)
2. Solids of revolution (20 hrs. classwork; 10 hrs. homework)
3. Review and solution of problems (18 hrs. classwork; 9 hrs. homework)

TRIGONOMETRY

(2 hrs. per week; total 66 hrs.)

1. Solution of oblique triangles (18 hrs. classwork; 9 hrs. homework)
2. Inverse trigonometric functions (14 hrs. classwork; 7 hrs. homework)
3. Trigonometric equations (16 hrs. classwork; 8 hrs. homework)
4. Practical exercises (6 hrs.)

[18] This curriculum was in use in about one-half of the schools in 1957–58. A newer curriculum requiring a total of 5 hrs. per week was in use in the other schools.

5. Review of trigonometry course and solution of geometric problems (12 hrs. classwork; 6 hrs. homework)

The Teaching of Physics

The official syllabus for the physics curriculum in the schools sets forth the following aims:

> To enable pupils to orient themselves correctly with regard to natural phenomena used to understand the basic industrial processes; to understand basic principles of mechanics, sound, heat, electricity, magnetism, and light; to understand atomic structure; to serve the goals of a Communist society; to prepare youth for future practical activity; to select a vocation or profession upon graduating; to understand the material world, the interrelations of physical phenomena and the objective laws of nature, and the formation of a materialistic world-view and scientific thought.

The syllabus goes on further to say:

> The formation of a scientific world view is inseparable from the struggle with religious prejudices and superstitions. Laws such as the conservation and transformation of energy, the law on the conservation of momentum, and the concept of the indestructibility of matter are basic for the atheistic education of pupils. The reactionary role of the church in the fight with progressive science should also be pointed out in the physics course.[19]

RELATION TO POLYTECHNIC EDUCATION

The study of physics is a necessary element in polytechnic education. Means of production, such as machines and mechanical and electric power, are based upon physical principles and processes. The close relationships between physics and the fundamentals of production is made clear to the pupils, and the application of physical laws and principles to technology is emphasized. It was a natural consequence, therefore, that we observed that many physics teachers were also teachers of such courses as electrotechnics.

An attempt is made, where possible, to give pupils an opportunity to apply their knowledge of physics while they are engaged in their production work. At the factory "Red Proletariat," in Moscow, we saw a number of pupils working with various kinds of calibration instruments under supervision of engineers and skilled technicians. Others were working with electric motors and machines. We were told that the pupils were expected to make minor adjustments and repairs to instruments and machines.

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[19] R.S.F.S.R. Ministry of Education. *Programmy srednei shkoly. Fizika i Astronomiia.* (Syllabuses for secondary school. Physics and Astronomy.) Moscow, Uchpedgiz, 1958. 53 p.

ASPECTS OF THE PROGRAM

The study of physics commences in the 6th grade and continues in every grade thereafter through the 10th grade. Elementary notions of mechanics, heat, and electricity are taught in grades 7 and 8. These same topics are likewise taught in grades 8, 9, and 10 but in greater depth and more systematically with the aid of the mathematics which has been learned. Alternating current, electromagnetic vibrations and waves, optics, and atomic structure are topics which are introduced for the first time in the 10th grade.

GRADE 6

The course in physics begins in the sixth grade with an introduction to properties of matter. Pupils learn units of measurement and such fundamental concepts as length, area, volume, mass, weight, and force. By means of specific gravity, pupils acquire a knowledge of light and heavy materials.

Concepts of pressure and force are explained by the aid of such practical applications as building foundations, needles, knives, cutters, and chisels. Liquid pressure is explained by means of Pascal's Law. The bouyant forces which act upon a submerged body are calculated in accordance with Archimedes' Law.

In the unit on mechanical motion are taught concepts of speed with examples taken from technology. In the theme, work and power, pupils learn about simple mechanisms and their applications to levers and pulleys. Supported by examples of water power and winds, pupils are taught the distinction between potential and kinetic energy.

The program for the sixth grade requires the completion of the following 7 experiments:

1. Measurement of body dimensions by means of a ruler.
2. Determination of the volume of a solid body by means of displacement of a liquid.
3. Weight of bodies.
4. Measurement of force with the aid of the spring balance.
5. Use of the plumb line.
6. Use of the barometer in the calculations of atmospheric pressure.
7. Use of simple mechanisms, like levers and pulleys.

GRADE 7

The first part of the course in physics in the seventh grade is devoted to the study of heat. First, pupils are given elementary

notions on the structure of matter, molecules, liquids, and gases. Then they are taught about the expansion of bodies due to heat, the transfer of heat, and the measurement of heat. Various kinds of heat engines are explained and illustrated.

The second half of the course concerns electricity. Pupils learn how an electric current is produced and how current, resistance, and voltage are measured. Ohm's Law is studied, and pupils become acquainted with electromagnetic phenomena. Seven experiments are required, and pupils acquire skills and knowledge in the following techniques:

1. Measurement of temperature by means of a thermometer.
2. Use of a calorimeter.
3. Graphical representation of temperature occurring during the heating of a body.
4. Operation of the steam engine and identification of its parts, such as valves, governors, etc.
5. Operation of the internal combustion engine and the identification of its parts.
6. Rules of safety during experiments with heat sources and electric equipment.
7. Ability to read electric instruments.
8. The assembly of the galvanic battery.
9. Use of the ammeter.
10. Use of the voltmeter.
11. Various type of rheostats.
12. Understanding of the calibration of electric light bulbs.
13. Use of thermoelectric devices.
14. Determination of the polarity of the poles of a permanent magnet by means of the magnetic needle.
15. Determination of the polarity of the of an electromagnet by means of the direction of the current in the coil.
16. The wiring of an electric bell.

GRADE 8

The course in the eighth grade commences with a study of mechanics. Pupils learn about uniform motion, uniformly accelerated motion, and inertia, as well as the resolution and composition of forces. Under the topic of mechanical energy they study about simple machines and the law of equilibrium. Included among the required demonstrations and experiments in this grade are:

1. Measurement of the dimensions of a body by use of the micrometer.
2. Weight of a body.
3. Use of the stop watch.
4. Use of the tachometer.
5. Construction and reading of graphs.
6. Measurement of the power of an electric motor by means of the break-band.

GRADE 9

The study of mechanics is completed during the first part of the ninth grade. The pupils learn about curvilinear motion and centrifugal force. The next unit is on vibrations and waves which lead to a study of the phenomenon of sound. The actions of liquids and gases are illustrated by means of the carburetor and the water pump.

In the theme, molecular physics and heat, the pupils begin a study of molecular kinetic theory as a basis for understanding thermal phenomena. They are required to know and characterize the mass and size of molecules and also the number of molecules in a cubic centimeter of gas. Ten experiments and demonstrations are required to be performed, including the following:

1. Construction and performance of the carburetor.
2. Use of the calorimeter.
3. Determination of the humidity of the air by means of the hygrometer.
4. Construction and performance of the steam engine.

GRADE 10

The unit of electricity covers electric and magnetic fields and laws relating to them, ionization, and charging of particles. The pupils have already received some instruction in these topics while studying chemistry in the seventh grade. In studying direct electric currents, they receive a picture of the nature of electric currents in metals, gases, and in the vacuum.

In the next unit the pupils learn about the phase, period, and frequency of alternating currents. Particular attention is given to three-phase current. In the topic of electromagnetic oscillations and waves, attention is concentrated on transformers and magnetic fields produced by coils. The principles underlying radar are explained. Emphasis is given to the great contributions made by scientists and inventors and their applications to the advancement of technology.

The concluding unit in the physics program is on optics and

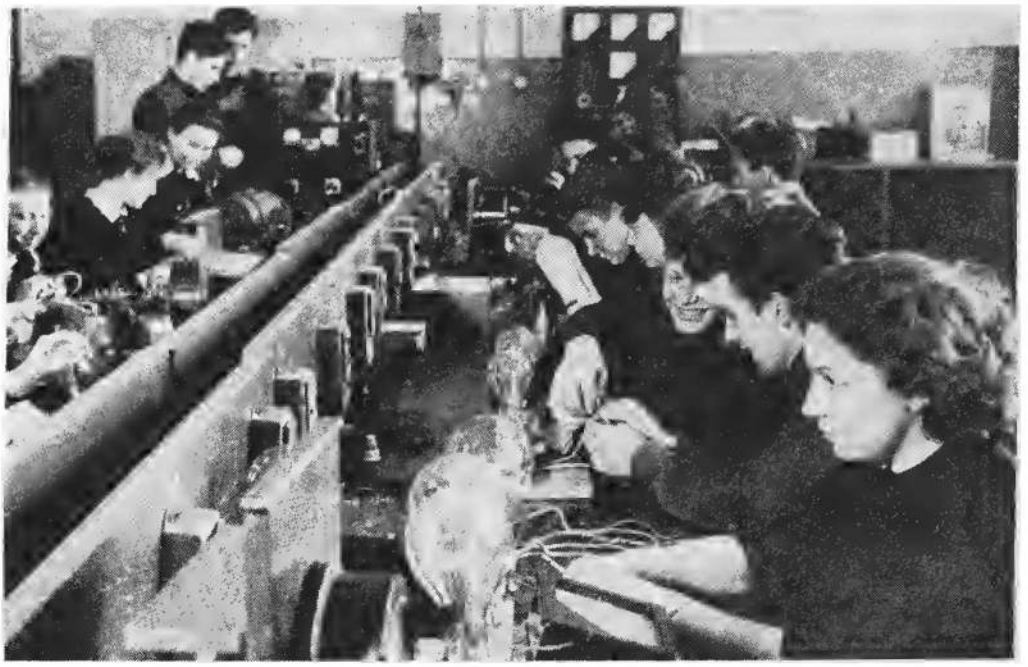


Figure 2-5.—Eleventh graders in electrotechniques laboratory.

atomic structure. The pupils learn about the reflection and refraction of light and the effects of light. The photoeffects of light are explained by means of luminescence and chemical action, with reference to the experimental work of P. N. Lebdev. In the study of structure of the atom, pupils are taught about energy levels of electrons, isotopes, and the peaceful uses of atomic energy. Thirteen experiments and demonstrations are required, among which are the following:

1. Assembly of electric circuits
2. Operation of the electric motor
3. Use of the photometer
4. Determination of the focal length of a lens
5. Assembly of the telescope and microscope
6. Use of the spectroscope

VISITS TO CLASSES

We had an opportunity to observe physics classes and facilities during our visit. In one class which was following the new experimental 11-year program, students were reviewing topics for final examinations. They were discussing the nucleus of the atom and the arrangement and motion of the electrons about it. The instructor was explaining the equation $hv = E_h - E_k$ and

how a radiation of a certain frequency was emitted when an electron shifted from one energy level to another. A pupil was called upon to explain why X-rays have such high frequency. A film was then shown on the production and use of atomic energy. The teacher proudly told us that the most talented physics pupil in the class, in the entire school in fact, was a daughter of a working mother.

Another physics class we visited was a 10th year physics class at a regular 10-year school in Kiev, composed of 22 girls and 1 boy. The instructor was an older man, and he was explaining how the mass of the nucleus corresponds to the atomic number in the periodic table. He discussed the energy levels of the electrons and how isotopes differed from the regular atom. The instructor lectured during the entire period, and the pupils took notes. We examined the textbook being used in the course.[20] The chapter headings were as follows:

Part I. Electricity and the Electromagnetic Field

1. Electricity
2. Magnetic fields produced by electromagnetic induction
3. Properties of electricity
4. Electromagnetic waves

Part II. Atoms and Optics

1. Dispersion of light
2. Spectra
3. Optical instruments
4. Light waves and wave propagation
5. Effects of light
6. Atomic structure. Atomic fission.

An example of class quizzes was one which had recently been given in an eighth grade physics class.

A Quiz Given in Eighth Grade Physics

1. The radius of a shaft is 6 centimeters, and the radius of the crank handle is 20 centimeters. The efficiency of the hoist is 90 percent. What is the actual mechanical advantage of the hoist?
2. What force must be applied to the rope of a single fixed pulley in order to raise at a uniform rate a weight of 96 kilograms if the efficiency of the pulley is 0.8?
3. A screw which is part of a vise has a pitch of 5 millimeters. As the screw is turned, it meets a resistance of 10 kilograms. How much work

[20] The textbook used was *Course in Physics*, Part III, by A. V. Peryshkin and others, in a Ukrainian edition of 1958.

is performed on the screw during two revolutions? What force must be exerted at the end of the handle attached to the head of the screw in order to turn the screw if the radius of the handle is 10 centimeters?

PHYSICS CURRICULUM

Following is a topical outline of the official curriculum with hours of instruction for physics taught in grades 6 through 10, in the regular 10-year school:[21]

Physics Curriculum, 10-Year School, grades 6 to 10

Grade 6 (68 hrs., sic)

I. MECHANICS

1. Introduction (1 hr.)
2. Measuring length, area, and volume (4 hrs.)
3. Force of gravity (3 hrs.)
4. Specific gravity (5 hrs.)
5. Force and its measurement (3 hrs.)
6. Pressure (16 hrs.)
7. Forces acting on bodies submerged in liquid and gas (6 hrs.)
8. Mechanical motion (7 hrs.)
9. Work and power (4 hrs.)
10. Simple machines (6 hrs.)
11. Energy (2 hrs.)
12. Two excursions (6 hrs.)

Grade 7 (102 hrs.)

II. HEAT

1. Introduction: Structure of matter, molecules, liquids, gases (1 hr.)
2. Expansion of bodies due to heat (4 hrs.)
3. Transfer of heat (3 hrs.)
4. Measuring amount of heat (10 hrs.)
5. Changes in state of matter during heating and cooling (5 hrs.)
6. Heat engines (8 hrs.)

III. ELECTRICITY

1. Elementary notions (4 hrs.)
2. Electric current (6 hrs.)
3. Current, resistance and voltage (15 hrs.)
4. Energy and power of current (7 hrs.)
5. Electromagnetic phenomena (24 hrs.)

[21] *Programmy srednei shkoly. Fizika i Astronomia.* (Syllabuses for secondary school. Physics and Astronomy), *op. cit.*, pp. 21 ff.

6. Excursions (6 hrs.)
7. Review (9 hrs.)

Grade 8 (102 hrs.)

I. MECHANICS

1. Uniform rectilinear motion (10 hrs.)
2. Uniformly accelerated motion (16 hrs.)
3. Inertia. Composition and resolution of force (18 hrs.)
4. Force, mass and acceleration (10 hrs.)
5. Interaction of bodies (10 hrs.)
6. Mechanical energy (17 hrs.)
7. Practical exercises (10 hrs.)
8. Excursions (6 hrs.)
9. Review (5 hrs.)

Grade 9 (136 hrs.)

I. MECHANICS (continued)

10. Curvilinear motion. Rotary motion (17 hrs.)
11. Vibrations and waves (11 hrs.)
12. Sound (6 hrs.)
13. Action of liquids and gases (9 hrs.)

II. MOLECULAR PHYSICS AND HEAT

1. Principles of molecular-kinetic theory of the structure of matter (3 hrs.)
2. Heat and work (10 hrs.)
3. Expansion of a body during heating (4 hrs.)
4. Properties of gases (12 hrs.)
5. Properties of liquids (6 hrs.)
6. Properties of solids (8 hrs.)
7. Changes in the aggregate composition of matter (18 hrs.)
8. Heat engines (10 hrs.)
9. Practical exercises (10 hrs.)
10. Excursions (6 hrs.)
11. Review (6 hrs.)

Grade 10 (148 hrs.)

I. ELECTRICITY

1. Electrical charges and the electrical field (17 hrs.)
2. Electrical current (29 hrs.)
3. Magnetic field and electromagnetic induction (11 hrs.)

II. ALTERNATING CURRENT, ELECTROMAGNETIC VIBRATIONS, AND WAVES

1. Alternating electric current (16 hrs.)
2. Electromagnetic vibrations and waves (10 hrs.)

III. Optics and Atomic Structure

1. Diffusion of light (5 hrs.)
2. Reflection and refraction of light (10 hrs.)
3. Optical instruments (5 hrs.)
4. Wave properties of light (9 hrs.)
5. Effects of light (5 hrs.)
6. Structure of the atom (8 hrs.)
7. Practical exercises (6 hrs.)
8. Excursion (3 hrs.)
9. Review (14 hrs.)

The Teaching of Astronomy

Astronomy is taught one hour each week in the 10th grade. As explained in the official syllabus for the course, the purpose of teaching astronomy in the secondary school is to give pupils an elementary understanding of the universe, the movement of celestial bodies, and the position of the earth relative to them. The study of astronomy should also contribute to a refutation of religious beliefs.[22]

The first unit is on the diurnal rotation and annual revolution of the earth. The pupils learn about the apparent motion of the sky and the concepts of latitude and longitude in the determination of geographic locations and in navigation.

In the second unit, on the basic methods of astronomy, pupils are given an elementary understanding on how astronomical distances to the various celestial bodies are determined. They are taught the role of spectral analysis in the study of physics of the stars, with special emphasis on the sun. The 100 years of work of the Pulkov Observatory and the contributions of such Russian and Soviet scientists as Lomonosov, Struve, Bredikhin, Belopolskii, Shternberg are pointed out.

The motions and characteristics of the moon, planets, comets, and meteors are treated in the study of the solar system. Terrestial phenomena caused by the sun are discussed. Stars and star systems, their nature and movements, are taken up in the study of the structure of the universe. The importance of photography and spectral analysis in modern astrophysics is stressed.

[22] *Ibid.*, pp. 48 ff.

The subject of astronomy is concluded by a brief treatment of the theories concerning the origin of the universe and the evolution of celestial bodies.

ASTRONOMY CURRICULUM

Following is a topical outline of the official curriculum with hours of instruction for the teaching of astronomy in the 10th grade:[23]

Astronomy Curriculum, 10-Year School, Grade 10

(Total hours, 34)

Introduction (1 hr.)

I. Diurnal and annual changes in the appearance of the sky. Motions of the earth. Practical application of astronomy (9 hrs.) Observation (2 hrs.)

II. Basic methods of astronomy (4 hrs.)

III. Solar system (8 hrs.) Observation (1 hr.)

IV. Stars, star systems. and structure of the universe (4 hrs.) Observation (1 hr.)

V. Origin and evolution of celestial bodies (2 hrs.) Review (2 hrs.)

Pedagogical Research

Soviet educators do not believe that their curriculums and teaching methods have been by any means perfected. Concrete evidence of their dissatisfaction with them is clear in view of the sweeping reforms which are planned and the numerous critical articles which appear in the newspapers and educational journals. Specific references to this dissatisfaction have already been made in the preceding discussions, and some sentiments along this line were expressed to us in our talks with Soviet educators.

In order to overcome shortcomings and inadequacies, a significant attempt is being made in the numerous pedagogical research institutes located throughout the U.S.S.R. to study problems of education in the schools and means of effecting improvements. These research institutes are staffed by substantial numbers of subject-matter specialists who have broad backgrounds in teaching and research and who are employed full-time

[23] *Ibid.*, pp. 51 ff.

to do this work, unencumbered by other responsibilities. We had an opportunity to visit these institutes in Moscow, Leningrad, and Kiev, and talk to some of their research workers and learn from them what they are doing. Since these specialists are working on new curriculums and methods which have significant implications for future science and mathematics education in the schools, the following pages will summarize what we learned from them.

EDUCATIONAL RESEARCH ON SUBJECT-MATTER TEACHING

The various pedagogical research institutes have certain assigned responsibilities for research. The Scientific Research Institute of Pedagogy in Leningrad has the task of conducting research on subject-matter teaching. We made two visits to this Institute during our stay in Leningrad and talked to a number of research specialists in the sectors of science and mathematics. We were told by all of these research workers that their main problem now was to relate the teaching of their subjects to the new emphasis on polytechnic education.

Mathematics.—In the mathematics sector the specialist in charge explained to us that one of his tasks was to make higher mathematics simple enough for secondary pupils to understand but that his effort was complicated by the fact that it has never been determined what minimum mathematical knowledge should be possessed by a cultured person. This, he said, is a problem on which he has been working for 50 years, and he showed us a book that he had written 30 years ago on mathematics which he thought should be taught in the secondary schools.

Like some mathematicians in our country, he complained that mathematics is being taught just as it was centuries ago. He felt that there was imperative need that mathematics be taught in tune with modern times and technology. He emphasized the importance of visual concepts. Concepts of geometry, he felt, can be integrated with concepts of arithmetic through diagrams and visual aids. There should be unity in speech, action, and thinking in mathematical study, with transition from simple to complex ideas. He showed us some of the charts that he had developed and which were on display in his office, showing how to achieve these objectives.[24]

Biological Sciences.—There are six research specialists working

[24] Recent publications by this specialist, P. A. Kompaniets, are: *Simple Graphical Calculations in the Course of School Mathematics*, Moscow, Uchpedgiz, 1957, 60 p., plus plates; and *Some Problems in the Course of School Mathematics*, Publication No. 95, Moscow, "Izvestiia pedagogicheskikh nauk R.S.F.S.R.", 1958. 292 p., plus plates.

in the sector of biological sciences. The chief of the sector outlined to us the three major problems with which this sector was concerned:

1. Development of individual thinking in the pupils.
2. Effective use of visual aids.
3. Practical experience, not only by means of the school garden plot but also by laboratory work.

For 30 years this sector has been doing research work on the school plot theme. We were shown a diagram of what was considered an ideal school plot. It consisted of a rectangle with an area of half a hector and contained six divisions: (1) Decorative plants; (2) field plants (wheat, corn, barley, etc.); (3) garden and vegetable plants; (4) fruit trees; (5) plants and herbs used in the study of ecology and genetics; and (6) zoological section (bees, chicken, rabbits, birds, etc.). A fence of shrubbery and small trees enclosed the plot.

The chief of the sector showed us some of the publications produced by his sector, including his own books on botany, how to teach botany, and how to work with children on school plots. Two of his books on popular reading for children are examples of the efforts of these research workers: *Path to the Woods* and *Following the Tracks of Robinson Crusoe.*

Physical Sciences.—In the sector of physical sciences we were told that their main problems at the present time are:

1. How to teach the fundamentals of physical science.
2. How to connect these subjects between themselves.
3. How to teach the fundamentals of production in order to achieve true polytechnic education.

The research specialists in this sector are working on both the theoretical and practical aspects of these problems. Among other things they are studying how school laboratories and display cases should be organized and equipped.

The sector chief told us that Soviet educators do not believe that polytechnic education should be of a trade character. Rather, the aim of work in the factory or plant should be to teach the fundamentals of production in a real polytechnic sense. For this reason an attempt is being made to establish a close relationship between the teachers in the schools and the engineers in the factories in order that this goal can be achieved. One research specialist, a woman, visits both the schools and the factories. She conducts experiments which are designed to test the effectiveness of various educational practices. One of her recommenda-

Figure 2-6.—Members of Pioneer Club from 11-year school.

tions was that the pupil should master not only one operation or skill, but rather a complex of them. In the plant itself, an engineer should teach the theory, using pertinent literature, visual aids, simple projects, etc., but a foreman should be in charge of practical instruction.

We were shown some of the research work done in the sector of physical sciences, including a display of equipment which has

been designed to assist in the teaching of physics, chemistry, and astronomy. We examined two of the books produced in the sector, one by the sector chief, on *Methods of Teaching Physics*, and the other, by the woman specialist referred to, on *Mechanics and Machine Technology*.

EDUCATIONAL RESEARCH ON METHODS

Educational research on methods is the primary function of the Pedagogical Research Institute of Methods in Moscow. We made two visits to this institute, the first time on May 12 to talk to the director and some of his key staff on overall aspects of their work and a second time on June 4, after our return to Moscow, to talk to some of the research specialists in science and mathematics.

The director outlined to us the organization and the work of his institute which employs 120 research specialists. The institute is divided into sectors covering various fields of knowledge, each headed by a chairman and consisting of between a half dozen and a dozen specialists. In the sector of mathematics and drawing, for example, there are 10 specialists in mathematics and 2 in drawing, and in the sector of physics there are 8 specialists. The common task of all sectors, he explained, was the preparation of programs of study, syllabuses, visual aids, design and arrangement of facilities and equipment, and development of effective methods of teaching all subjects in all types of schools.

EXPECTED INNOVATIONS IN CURRICULUMS

The director of the Pedagogical Research Institute of Methods in Moscow gave us a general picture of trends in Soviet science and mathematics education, and we obtained more detailed and specific information in our later meeting with the specialists themselves.

Due to the new reforms being brought about by the present emphasis on polytechnic education, the most important problem facing their research workers in science and mathematics now is, according to Russian educators, subject-matter content. In order to make science and mathematics more closely connected to practical life, curricular changes are being planned in all subjects.

Mathematics.—There will not be much change in the arithmetic curriculum which extends from the first grade to the middle of the sixth grade. In the fifth grade instruction in calculation with decimals and ordinary fractions will be strengthened. In the present curriculum ordinary fractions are taught before decimals.

In the new proposed curriculum decimals will be taught first and an increased amount of time given to them.

Substantial changes are being planned in other subjects in mathematics. Subject-matter now studied in grades 8, 9, and 10 will henceforth be studied in grades 9, 10, and 11 of the new 11-year schools as they are established in lieu of the former 10-year schools. However, some parts of the material formerly studied in grade 9 will be transferred to grades 5 through 8, and some of the material in grades 5 through 8 transferred to the senior grades. Of course, the transferred material will be taught consistent with the maturity of the pupils at each grade level. Part of the material now taught in the senior grades will henceforth be excluded, and in its place will be given some new material never before taught. These changes, it was emphasized, were necessary in order to link the study of mathematics more closely to practical life.

According to the planning of the mathematics specialists with whom we talked, the new mathematics programs in the senior grades will be as follows. In grades 9, 10, and 11 the mathematics subjects studied will be known as (1) algebra and elementary functions and (2) geometry instead of as formerly (1) algebra, (2) geometry, and (3) trigonometry. No longer will trigonometry be regarded as a separate subject by itself. The topics presently studied in trigonometry will not be abandoned, but rather they will be reorganized and divided between geometry and algebra and elementary functions. The applications of trigonometry to geometry, such as the solution of triangles, for example, will be taken up in the study of geometry.

The new principal emphasis will be on the theory of functions, and it is for that reason that algebra has been revamped into algebra and elementary functions. The notion of functional dependence between variables and their graphical interpretations is considered to be fundamental and insufficiently treated in the present curriculum.

The amount of logarithmic calculations will be reduced. In its place some new material will be added. For example, the following types of functions will be added: $y = A \sin (kt + B)$ and $y = A \cos kt + B \cos kt$. More emphasis will be placed on the graphical solution of such problems as $\sin x = kx$ and $\log x = kx$.

The new course in the ninth grade, algebra and elementary functions, will begin with a review of previously learned material. Soviet teachers feel that the new material planned for the fifth through eighth grades will be more understandable to the pupils.

They also believe that some of mathematics studied in these grades is too difficult and lacks a logical basis which they hope will be provided through the curriculum reform. Henceforth in these grades more systematic attention will be given to the development of the real number system, roots of equations, and concepts of equalities and inequalities. In grades 9 and 10 will be studied trigonometric, logarithmic, and exponential functions. Graphical analysis will be emphasized in the study of these functions, and a concerted effort will be made to establish the connection between them.

In the 11th grade will be introduced the beginning elements of calculus, which is not at the present time a part of the regular mathematics curriculum. The concept of a derivative will be taught, together with its applications in solving problems of rates of change, slopes, and maxima and minima of functions. Experiments have previously been conducted by some of the research specialists in the teaching of this new material in some of the experimental schools attached to the research institute. The experiments did not prove too successful, primarily because the teachers were not sufficiently prepared to teach the new topics and the new material was not adequately adapted to the grade level of the pupils. However, the specialists feel that the difficulties previously encountered are being overcome.

In regard to geometry, the ninth grade will commence with a review of plane geometry. In this grade the main themes will be the notions of symmetry, similitude, transformations (translations and rotations), and geometric properties of plane figures (axes, foci, etc.). Material in the present geometry curriculum will be studied but with new approaches and greater depth. For example, the study of the metrical properties of triangles and circles will be transferred to the latter part of the curriculum where they will then be investigated with the aid of trigonometry. In grades 10 and 11 pupils will take a course in solid geometry.

Physics.—In physics a number of changes are being planned. In beginning physics in grades 7 and 8 the program in mechanics and electricity will be somewhat expanded. The study of sound and light phenomena will be introduced, and pupils will be given elementary concepts of atom structure. The number of obligatory laboratory assignments will be increased as well.

The instruction in physics in grades 7 and 8 will be from the elementary notions standpoint. Systematic study of physical principles with the aid of mathematics will take place in grades 9 through 11. The curriculum in these grades will provide for

the study of such problems as physics of the atom, ultrasound, semiconductors, and physical properties of plastics and their use in industry. Information on artificial earth and sun satellites will be presented.

The total number of academic hours devoted to physics in grades 6 through 11 in the new proposed curriculum is 603, of which 80 to 100 hours are devoted to laboratory work. This compares with 550 academic hours in the present curriculum, of which 50 to 60 hours are in laboratory work.

Chemistry.—The chemistry program which commences in the seventh grade is being considerably broadened. The course in grades 9 through 11 will acquaint pupils with the properties and structure of high-molecular compounds, their classification, and the basic methods of their synthesis. Particular attention will be paid to plastics, artificial and synthetic fibers, rubber, and the most typical methods of their commercial production.

Biology.—The program in biology will be expanded in the new curriculum. In grades 5 through 8 pupils will learn about flora and fauna and receive elementary knowledge of man's anatomy and physiology. A new subject, nature study, will be introduced in grade 4 in place of geography and natural sciences. It will devote considerable time to the study of local natural conditions and give the pupils the rudiments of natural sciences and geography. A new subject to be introduced in secondary schools, fundamentals of general biology, will be given in grade 9 for 3 hours a week.

Proposed distribution of hours.—The reader should bear in mind that the general 11-year school curricular reforms which have just been discussed are proposals which there seems good reason to expect will be implemented. The distribution of hours

Table 3. — Distribution of hours in science and mathematics in the proposed new 11-year curriculum (urban school)

Subject	Number of hours a week in grades										
	1	2	3	4	5	6	7	8	9	10	11
1	2	3	4	5	6	7	8	9	10	11	12
Mathematics	6	6	6	6	6	6	6	5	4	4	4
Nature study				3							
Biology					2	2	2	2	3		
Physics						2	2	3	4	4	2
Chemistry							2	2	2	3	2
Astronomy										1	

in science and mathematics in the new proposed curriculum is given in table 3. An indication that the new curriculum is being officially approved was a news article in *Pravda* on August 29, 1959, stating that the new school reform is in effect.

How new curriculum will be introduced.—We were told by the Soviet educators that the new curricular changes will be introduced by stages. The new curriculum will first be adopted in grades 1 through 5. Then, the new curriculum will be introduced gradually through successive grades until the entire reform is in effect by 1965 in all 11-year schools. Experimentation with the details of the curriculum in higher grades is to continue until they are finally and officially approved.

CHAPTER III

Polytechnic Education in the General Schools

Introduction

THE SOVIET CONCEPT of polytechnic education for general education schools in the Soviet Union has emerged primarily from the complex factors and forces that were discussed earlier in this study (see especially chapter I).

The following pages present specifically information about (1) the philosophy and purpose of polytechnic education, (2) polytechnic courses, (3) the new curriculum reforms, (4) organization and operation of school workshops and production training, (5) organization and methods of teaching polytechnic subjects, and (6) research.

Polytechnic education, as discussed in this chapter, deals only with the elementary-secondary general schools, which enroll the largest number of students in the Soviet Union. Completion of polytechnic education takes place upon graduation from the senior grades. Although the senior grades are at present optional, a high percentage of students enter these grades; the others attend vocational and technical schools, take correspondence courses, or go to work and possibly study part-time.

We learned that all schools have not been able to introduce the earlier polytechnic curriculum that was issued in 1957, but that efforts are under way to provide schools with equipment, materials, and qualified teaching personnel to implement the new ambitious program.

TERMINOLOGY

It is helpful for the reader to grasp the concepts behind the terms *polytechnic education* and *work experience education* in order to understand fully the kind of general educational program

now developing in the Soviet Union. The first term is Russian; the second, American. Although Soviet educators do not use the term "work experience education," the ideas of work experience are nevertheless interwoven in polytechnic education to implement their educational plan of combining manual work and academic education.

Definition of polytechnic education.—The term *polytechnic* is translated from the Russian word *politekhnicheskoe.* The root words in the term "polytechnic" are *poly* and *technic.* The prefix *poly* is derived from the Greek word *polys* meaning many or much, having or consisting of many. The word *technic* stems from the Greek word *technikos* and means art, artful, or mastering. After talking with Soviet educators and observing their schools, we feel that polytechnic education in the U.S.S.R. is the kind of education which deals with understanding the various technics of industrial and agricultural production; the application of scientific principles to mass production; the organization and utilization of workers; the development of habits of work and technical abilities; and the planning of jobs involving self-discipline and initiative.

Work experience education.—The reader will encounter several different terms used to describe certain aspects of Soviet polytechnic education. Some of these terms are labor program, labor education, labor production, socially useful work, productive labor, productive practice, summer practice, industrial practice, productive work, labor training, production education, and production training.

These terms, as translated to us, are used within the context of this report to convey varying shades of Soviet meaning. Essentially, these terms reflect the Soviet belief that their general schools should provide some form of what we could call *work experience education.*

As reported by the Office of Education, in Bulletin 1957, No. 5, "The term 'work experience' when studied etymologically refers to any activity in which an individual engages resulting in the production of useful goods and services. To include the social and intellectual effects of this experience on the individual, a broader term has been proposed—'work experience education.' "[1] The bulletin further reports that "Work experience education may achieve both vocational and general education goals. Likewise,

[1] *Work Experience Education Programs in American Secondary Schools.* (Office of Education Bulletin 1957, No. 5.) Washington, U.S. Government Printing Office, p. 4.

it embraces both paid and nonpaid work done by students enrolled in the program. The most significant aspects of an educative work experience program include arranging for the work to be done on school-released time, providing supervision by the school, granting credit, and providing supplementary instruction related to problems of personality development, community relations, and job success."[2]

In Soviet general schools these "work experiences" occur in school or during school-released time. They also embrace both paid and nonpaid work done by the students; and a coordinating group made up of school and industry officials plan the educational program.

Philosophy and Purpose of Polytechnic Education

We learned in our discussion with Soviet educators that they believe quite strongly that all students need to know about the fundamentals of mass production. The aim is not only to understand production in a passive way, but also to have students participate actively in school workshops and in industry, so that they can get an intimate knowledge of how an industrialized nation produces the goods and services that it needs. U.S.S.R. educators indicate that each student should be able to take an active part as a *worker* in some phase of the economy of their vast land.

We also learned that they were concerned about the attitude some adults and youngsters display toward state-owned equipment and property. They feel that students working in workshops on worthwhile tasks can be taught to respect property and to use it as if it were their own. And, they express the wish to instill in their pupils the love of labor and respect for the laboring man—the worker. In other words, they intend that the school is to be the vehicle to implement certain fundamental concepts of Soviet morality and philosophy. The student, they believe, should also see the fruits of his labor and receive some remuneration for the work performed.

Another factor that shapes Soviet education is the theory of Soviet educators that general elementary-secondary schooling should provide a background or base upon which all professions and vocations can be built.

One of the primary purposes of polytechnic education in the

[2] *Ibid.*, p. 5.

Soviet Union is to provide fundamental technical knowledge common to all industrial fields. It is broad rather than narrow training. Their educators hold that it helps students express themselves through polytechnic experience; that students get professional orientation which enables them to choose their professions more intelligently. Polytechnic education is a better preparation for life, they say. In the process of acquiring this knowledge practical habits of measurement, drawing, and laboratory techniques develop. It also gives the student experience in labor production in school. And, in the future, Soviet industry will be using automation to an ever increasing degree, and students will need to know more polytechnic information to adjust to the new machinery and ways of production. Such are some of the purposes of polytechnic education as stressed by Soviet educators.

RELATION OF POLYTECHNIC EDUCATION TO OTHER STUDIES

It was pointed out numerous times to us that the general subjects are the first in which to emphasize polytechnic education, and that mathematics and science form the bases of polytechnic education. Even though there is a direct correlation between polytechnic courses and mathematics and science courses, Soviet educators are striving to bring about an even greater relationship between them and all areas of instruction.

For example, in botany classes fifth graders are taught about different kinds of trees, and in woodworking classes they are taught what can be done with the trees. One educational researcher explained how polytechnic education is correlated by teaching mathematics. He used the illustration of a metal box that could be made in two different shapes yet have the same volume. However, the exposed surface of the box was greater in one shape than in another. Polytechnic education would be related to this problem, he said, because if industry had to heat this metal box, more energy would be expended if it were of one shape because of its greater exposed surface. His major point was that in the teaching of mathematics, other factors are being considered and attempts made to correlate mathematics with problems close to life—in particular, industrial life.

Soviet educators told us about the changes made to improve the teaching of physics in order for students to understand better the foundations of production. In the revisions of the physics course, the fundamentals of technics were left in so as to help bring about a relation between theory and practice. During the revision of the polytechnic course in electrotechnics they found

that certain principles needed to be included in their physics courses to give the necessary theoretical understanding. As a result, information is now presented in physics classes about (1) principles of semiconductors, (2) modern automation principles, and (3) solid bodies (given more emphasis). It was emphasized to us that these changes in the curriculum brought about a closer relation of the school curriculum to life.

Since one of the main branches of production deals with chemical production, new topics were introduced in chemistry dealing with (1) chemical industries, (2) production of salts, (3) metallurgy, (4) extraction and refining of gases and fuels, and (5) chemical elements. They want to give students a better notion of molecular theory and they have discarded unnecessarily complicated problems in their old syllabus.

Formerly mathematics had a great deal of calculation, but something was lacking. The students, they felt, should get an idea that mathematics can be applied to the practical as well as the theoretical. This is of great importance, we were told. To improve their mathematics courses, the functional theory is introduced in the fifth grade, and the students will study mathematical principles which can be applied to life. The student is expected to understand the applications of the theoretical concepts also. There must be a balance between the applied and the theoretical, we were told. Nor was their main purpose of mathematics—that of developing logical thinking—overlooked in making these changes in the curriculum.

Another example showing how physics can be correlated with polytechnic education is shown on table 9, page 163. This table points out that in discussing problems of thermal action of electric current the students should be taught about schematic drawings, devices that use scientific principles, how these devices work, and their construction.

Polytechnic Courses

Although all courses in the school are being designed to contribute toward polytechnic education, certain courses, along with mathematics and science, do so more specifically. These are: labor (manual arts) as a subject in grades 1 through 4; labor training in grades 5 through 7; principles of production (industrial and agricultural) in grades 8 and 9; technical drawing in grades 7 through 10; electrotechnics and automobiles or tractors in grade 10.

Drawing in grades 1 through 6 includes art instruction and is not generally referred to as a polytechnic course. It is reported here because of the extent to which drawing is taught in the elementary grades prior to the student's taking *technical drawing,* and, because all drawing is so basic to achieving polytechnic education.

In addition to these courses, students also spend time working during the fall and spring in the school parcel of land (garden), and have industrial practice after school and for several weeks during the summer months. And students get experience in production work at an enterprise or collective farm during the ninth grade. See appendix I, table B, for further details on the 10-year curriculum that was being implemented during the 1958-59 school year.

Another way students supplement their school experience is through participation in "Pioneer Circles." These circles help provide students with an outlet for their individual interests. In one school in Moscow, we saw four boys returning to the woodworking shop to make repairs on their model airplanes which they had constructed in one of the circles.

LABOR AS A SUBJECT IN GRADES 1 THROUGH 4

Some of the specific aims of this instruction is to stimulate initiative and design creativity in pupils, to help them develop skills in drawing and in measuring precisely, and to become acquainted with the properties of materials. Soviet educators consider these activities as a form of labor.

Manual arts.—In grade 1, students work with paper, cardboard, scissors, and paste; sew with needle and thread; work with clay (oil mixed with clay); and care for plants and animals. These same activities are carried out in grades 2, 3, and 4. However, in grade 4, students also bind books and do *technical modeling.* Actually, in technical modeling, they make toys and models of machinery like tractors, cranes, gliders, and even parachutes.

We saw many of the objects made by students, such as simple figures and bowls made by pinching, rolling, and pressing clay in various shapes. Much in evidence were houses, barns, and windmills, made from paper and cardboard. Each article was painted nicely to resemble the original. Such activities are conducted in the classrooms with students working at their desks. (See fig. 1–4, page 28.) One Soviet teacher expressed the hope that they would eventually have a separate room for this kind of work.

The school system provides the necessary supplies and equipment such as rulers, knives, scissors, needles, embroidery frames, brushes, shovels, watering cans, saws, chisels, and vises. See list of equipment for study in manual labor for grades 1 through 4, page 137.

Drawing.—In grades 1 and 2 students draw with crayon and water color. They incorporate the ideas of perspective, shading, and color. The student is taught to apply the skill of observation in his drawings. In grades 3 and 4 the students are taught about the size of objects and the distribution of light and shade. Students in grade 6 receive instruction in drawing perspective views, such as in a picture with a horizon, using space in relation to picture, the role of colors in paintings, and how to use water color.[3]

Applying perspective, developing creative imagination and initiative, and understanding the relationship between objects at different distances are part of thematic drawing. Decorative drawing includes the study of geometric and national art designs. Discussion and analysis of art such as paintings and reproductions—both prerevolutionary and Soviet paintings—are also required. Table 4 shows the subjects studied in drawing, with the number of hours, in grades 1 through 6.

Table 4.—Drawing (grades 1 through 6)[1]

Subjects studied	Total hours	Hours per grade					
		1	2	3	4	5	6
1	2	3	4	5	6	7	8
Drawing from nature	116	14	17	20	21	22	22
Decorative drawing	42	11	10	7	6	4	4
Thematic drawing	30	8	6	4	4	4	4
Discussion of art	10	------	------	2	2	3	3
TOTAL	198	33	33	33	33	33	33

[1] Ministry of Education of R.S.F.S.R., *Programmy srednei shkoly, Risovanie.* (Syllabuses of Secondary School. Drawing.) Moscow, Uchpedgiz, 1958. P. 2.

Examples of some of the subjects in drawings made by students are doors; windows; cylindrical and conic objects, such as boxes, cans, and flower boxes; illustrations from fairy tales; decorative wallpaper; drawings from nature, such as the migration of birds;

[3] Ministry of Education of R.S.F.S.R. *Programmy srednei shkoly. Risovanie.* (Syllabuses for secondary school. Drawing.) Moscow, Uchpedgiz, 1958. 16 p.

sketches of benches and chairs; and pictures of posters for holidays. Students are also expected to discuss intelligently various paintings.

At the end of the 6th grade, students are expected to know how to use perspective and shade, and they should be able to draw from nature from memory. They should be able to use water colors and make posters, and be able to recognize distinguished painters, and understand the history behind each painting.

LABOR TRAINING IN GRADES 5 THROUGH 7

Soviet educators believe that these courses help students understand other subjects, develop respect for work and State property, develop good habits of measurement, drawing, and laboratory techniques, and learn the basic elements of production work.

Woodworking.—Students receive instruction about wood and its qualities, the advantages and disadvantages of various woods, the technical qualities of wood, plain and quartered sawed lumber,

Figure 3-1.—Sixth-grade boys in woodworking class (labor training).

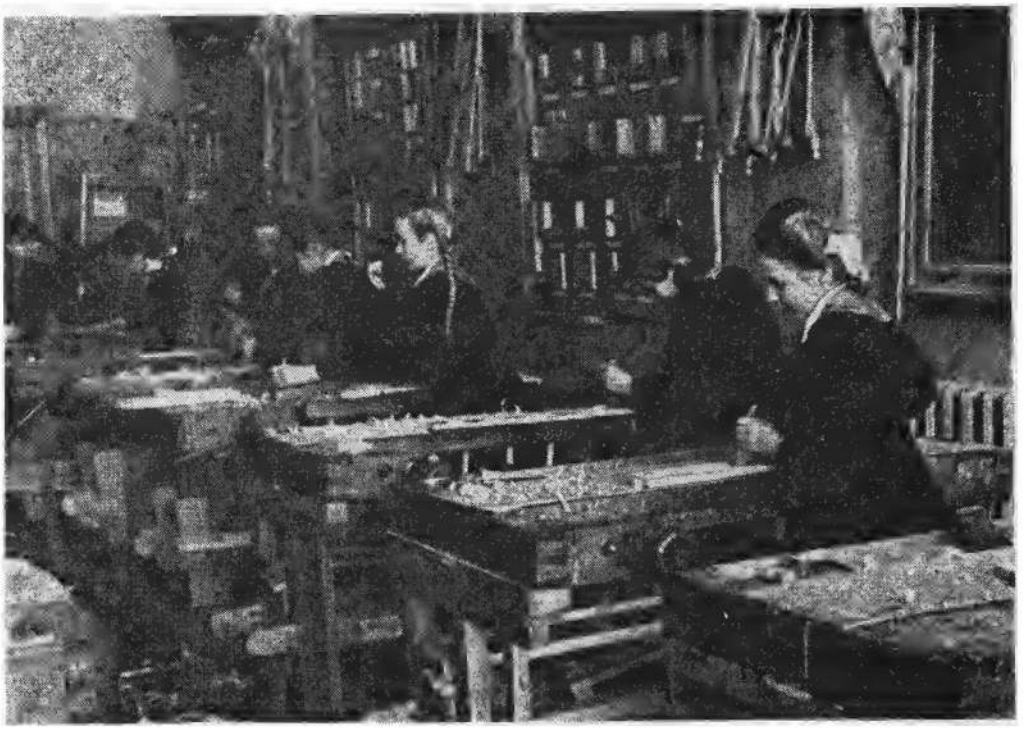
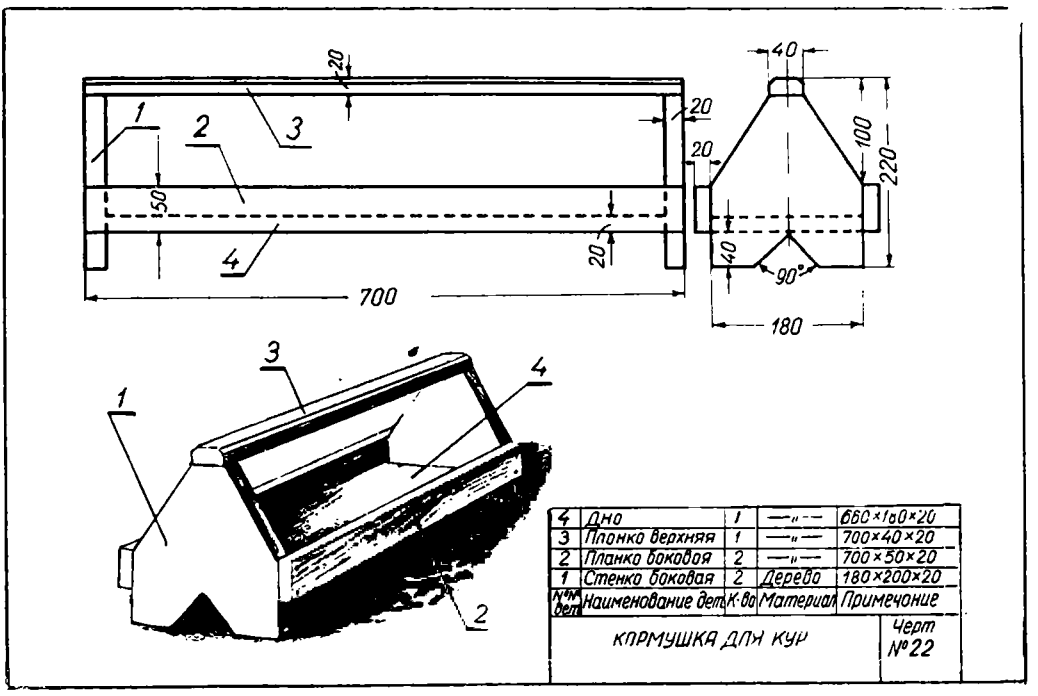


Figure 3-2.—Sixth-grade girls in woodworking class (labor training).

drying, and the preservation of wood. They also learn how to cut wood and use the equipment and instruments (tools) of a jointer (woodworker). (See fig. 3-1.) In one woodworking shop students were cutting out handles for tools. One boy, using a hand plane made of wood (except for the metal planeiron), was planing a rake handle held in a wooden vise.

Mostly hand-operated tools are used by the students in these classes, to perform such operations as marking, cutting, planing, drilling, and chiseling. (See fig. 3-2.) Most of the useful articles were put together with screws, glue, and nails. Articles are sandpapered and finished using a sealer, with either a translucent finish, paints, or enamel. (See fig. 3-3 and fig. 3-4.)

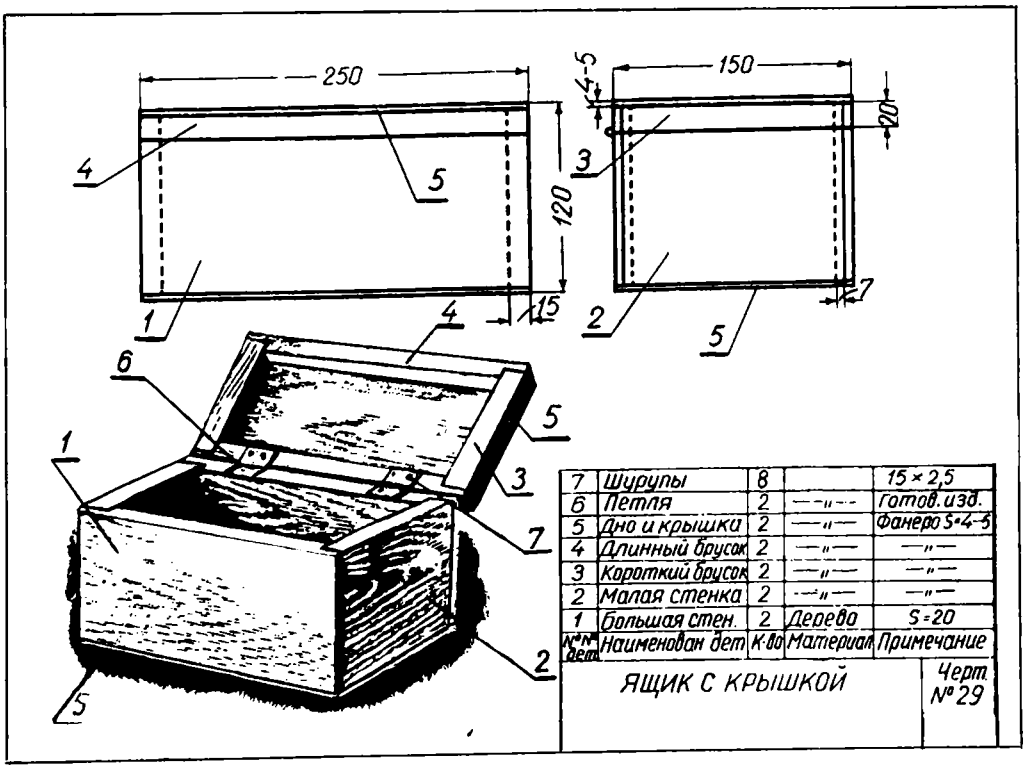
Metalworking.—Students must know about ferrous and nonferrous metals and their alloys, and get a general understanding of their qualities. They do bench metalwork at their work station and learn about safety rules. Various hand operations are taught, such as cutting with snips, chiseling, shaping, filing, bending, drilling, cutting threads, and finishing metal objects. (See fig. 3-5 through fig. 3-8 for illustrations of the shop work.) Notice that the article in fig. 3-8 can be used in a physics laboratory.



№ поз.	Наименование дет.	К-во	Материал	Примечание
4	Дно	1	—"—	660×180×20
3	Планка верхняя	1	—"—	700×40×20
2	Планка боковая	2	—"—	700×50×20
1	Стенка боковая	2	Дерево	180×200×20

КОРМУШКА ДЛЯ КУР — Черт №22

Figure 3-3.—Feedrack for chickens.

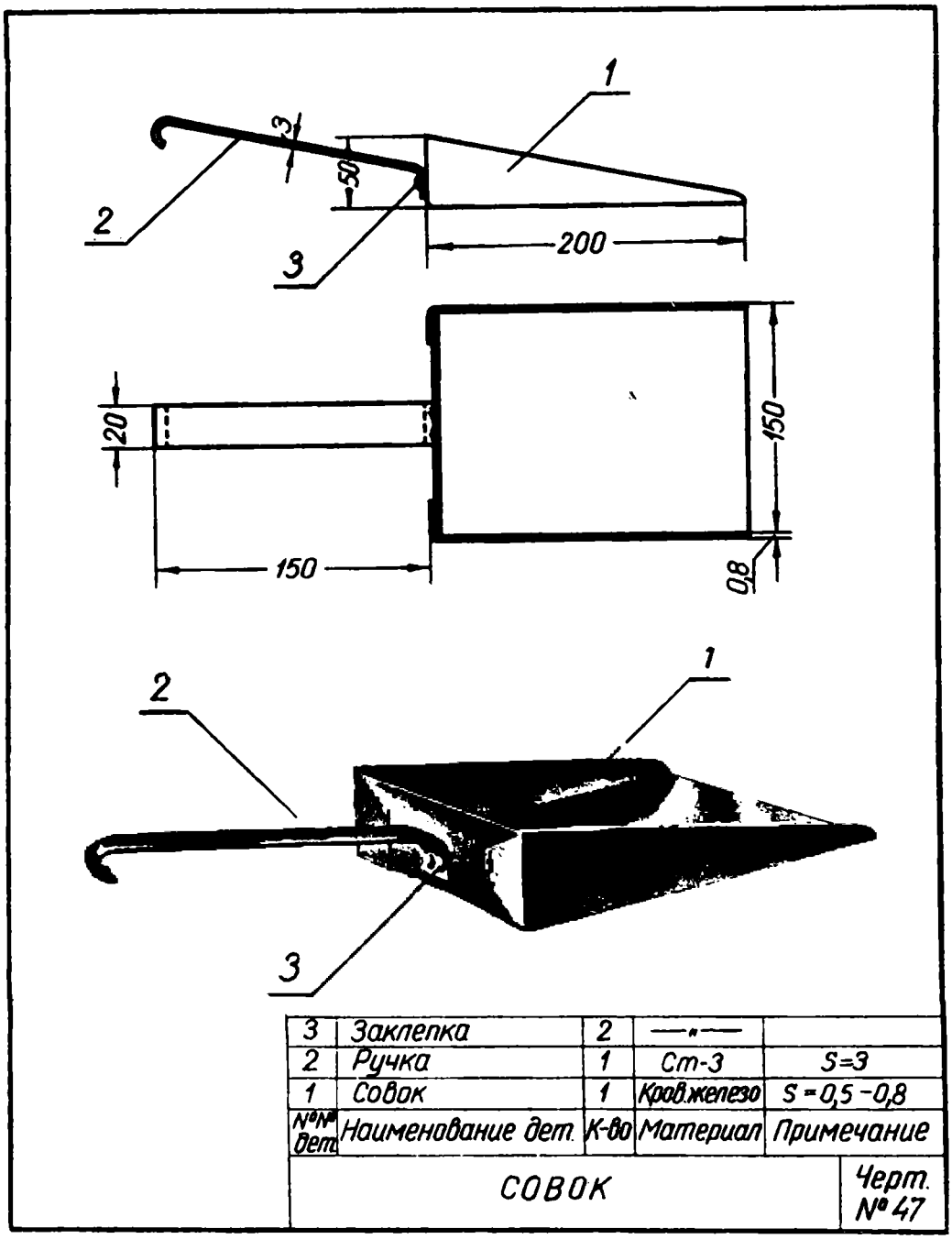


№ поз.	Наименование дет.	К-во	Материал	Примечание
7	Шурупы	8		15×2,5
6	Петля	2	—"—	Готов. изд.
5	Дно и крышка	2	—"—	Фанера S=4-5
4	Длинный брусок	2	—"—	—"—
3	Короткий брусок	2	—"—	—"—
2	Малая стенка	2	—"—	—"—
1	Большая стен.	2	Дерево	S=20

ЯЩИК С КРЫШКОЙ — Черт №29

Figure 3-4.—Box with a cover.

We learned that many articles made in the workshops, such as test tube stands, chemistry racks, and apparatus for demonstration of waves, were for the science laboratories. Fig. 3-9A shows a display of some of the useful articles, such as rakes, tin cups, trowels, and small pails, students make in metalwork.



3	Заклепка	2	—"—	
2	Ручка	1	Ст-3	S=3
1	Совок	1	Кров.железо	S=0,5-0,8
№№ дет.	Наименование дет.	К-во	Материал	Примечание
	СОВОК			Черт. №47

Figure 3-5.—Dustpan.

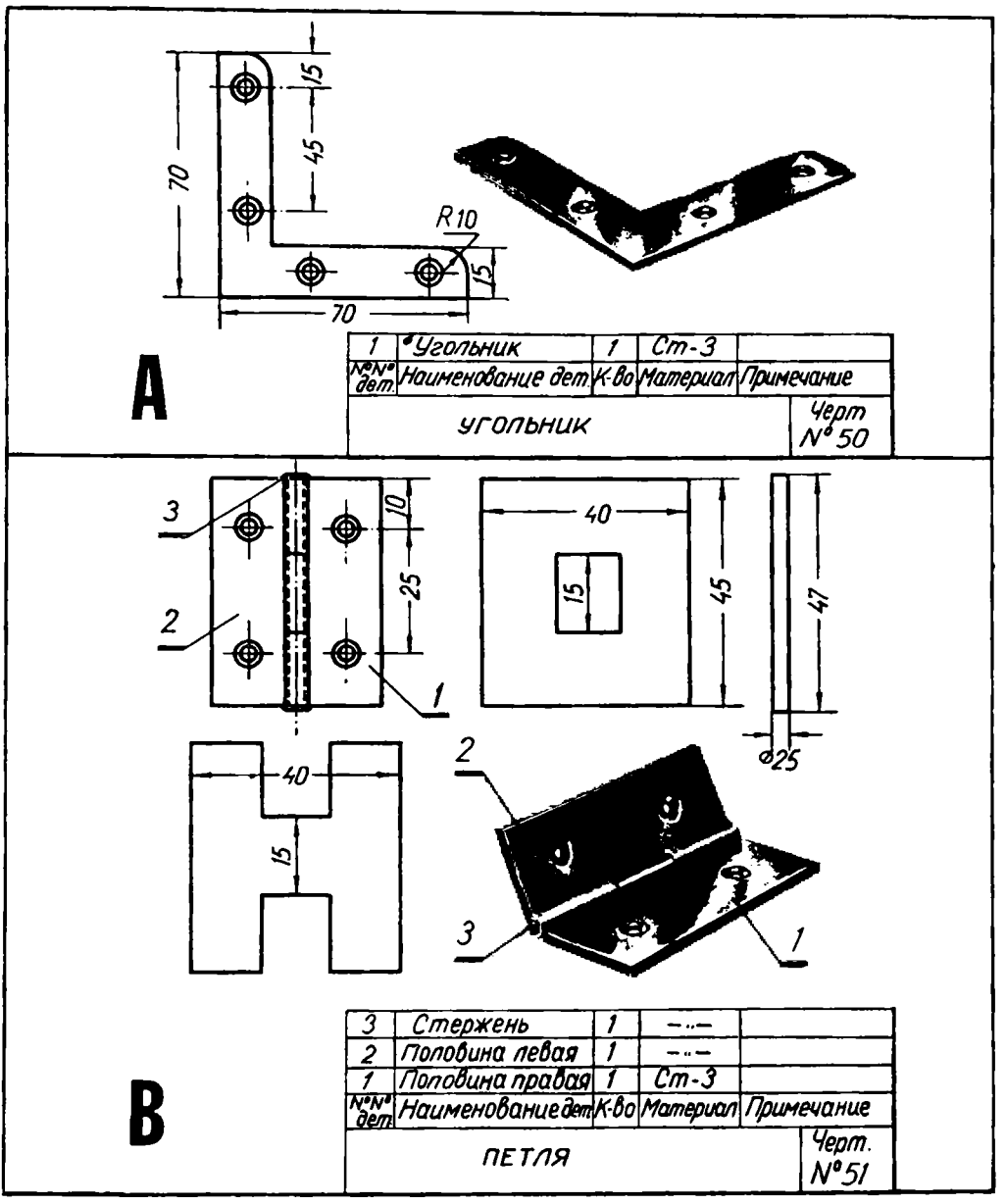
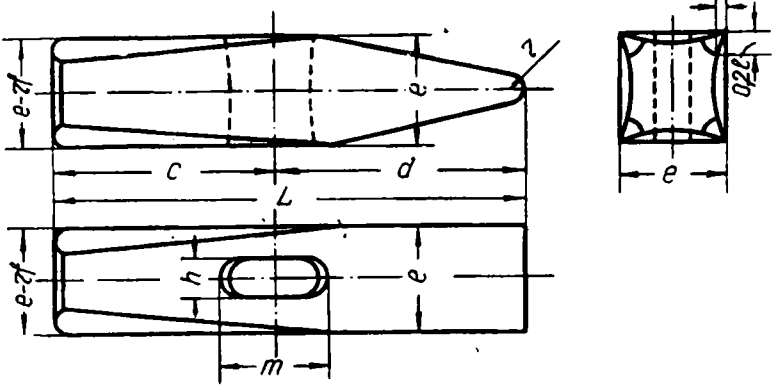
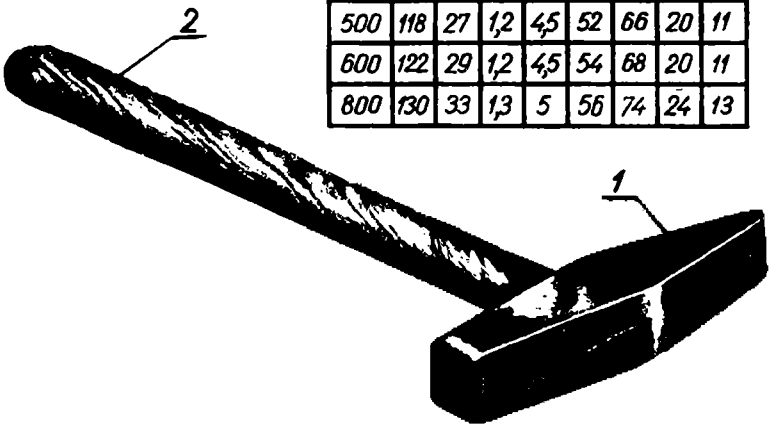


Figure 3-6.—(A) Flat corner iron and (B) hinge.

Electrical work.—In addition to working with metal, pupils in the metalworking shop are required to gain elementary understanding of electric work and lighting. They study transmission and distribution of power and insulation procedures, plan and do electric wiring, and draw schematics. Experience is acquired in using house wiring devices and doing elementary house wiring. Electrical appliances, their construction and operation, are also studied. Fig. 3-10 and fig. 3-11 A & B show two of the articles representative of this type of work.



Вес гр.	L	e	f	z	c	d	m	n
50	75	11	0,7	1,5	34	41	12	7
100	82	15	0,7	2	36	46	16	9
150	88	17	0,8	2,5	40	48	16	9
200	95	19	0,9	3	43	52	16	9
300	105	23	0,9	3,5	48	57	20	11
400	112	25	1	4	50	62	20	11
500	118	27	1,2	4,5	52	66	20	11
600	122	29	1,2	4,5	54	68	20	11
800	130	33	1,3	5	56	74	24	13



№ № дет.	Наименование дет.	К-во	Материал	Примечание
2	Ручка	1	Дерево	Береза
1	Боек	1	Ст-7	У7 – У10
МОЛОТОК СЛЕСАРНЫЙ				Черт. № 74

Figure 3-7.—Mechanic's hammer.

From our observations, the electrical phase of instruction seemed to be the weakest in grades 5 through 7. Steps, however, are said to be under way to correct this, and in one school we visited the instructor proudly showed us a shop laboratory that he and his students had built during the year, which was fitted

for electrical work and lighting. The facilities will be used for the first time during the 1959-60 school year.

School plots.—These school plots (gardens) provide for an integral part of the labor training in these grades, as well in the other grades. The practical work on the plots serves as a supplement to science courses in botany and zoology. Experi-

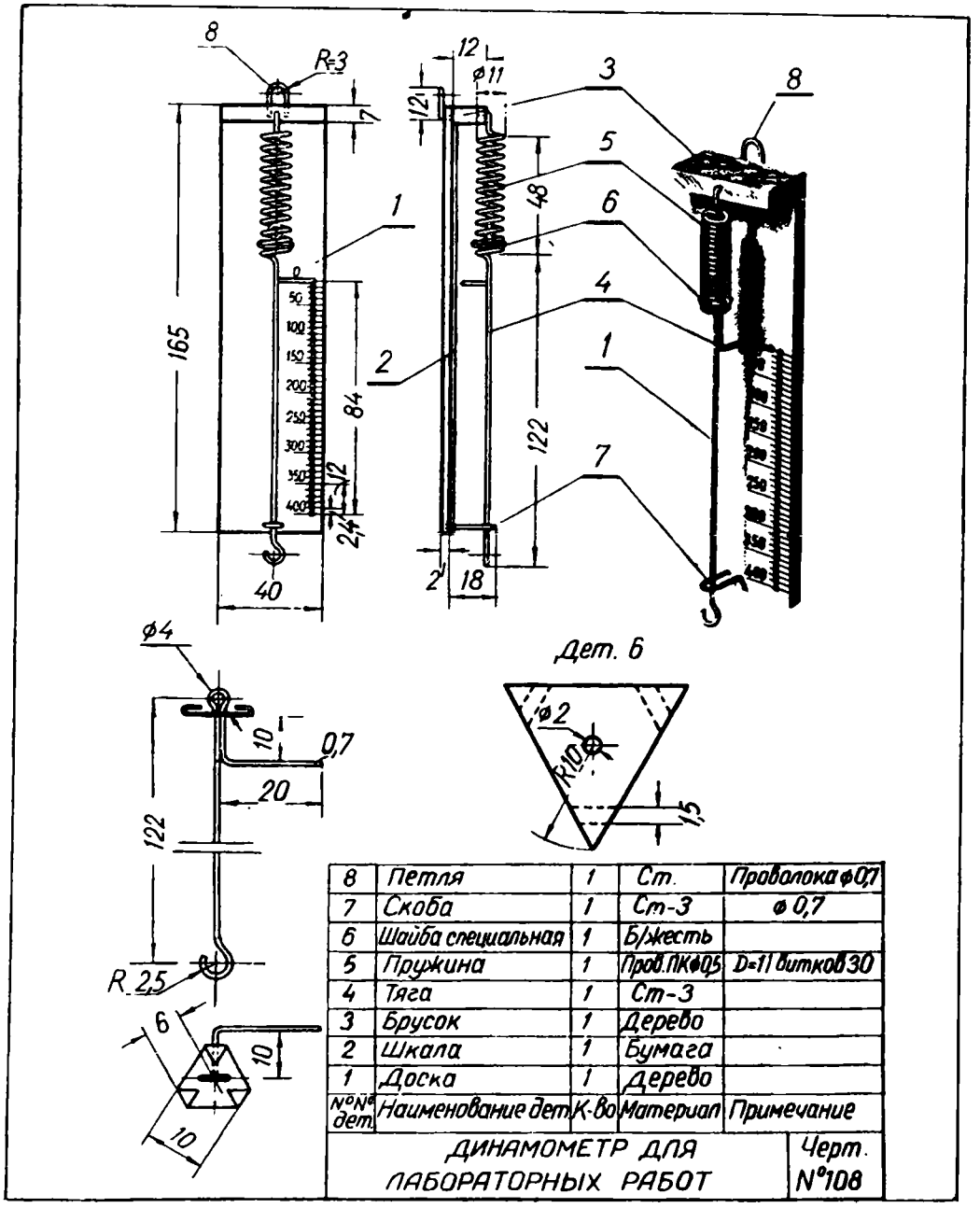
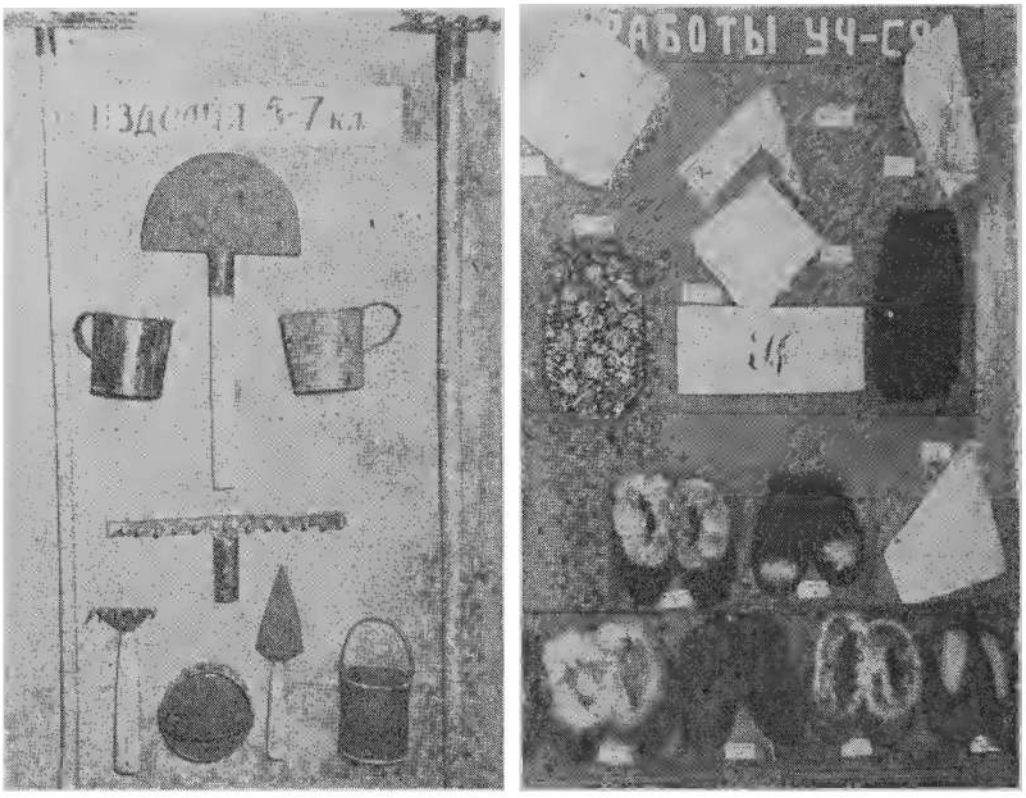


Figure 3-8.—Dynamometer for laboratory work.



(A) (B)

Figure 3-9.—Illustrations of useful articles made by students in grade five and above.

ments are conducted during the year under the supervision of the teachers. Students in the fifth grade grow vegetables and soft and hard fruits. Other socially useful work entails tree planting and keeping the school grounds clean and orderly, activities which are done, however, after school. All youngsters participate in working on the plots during the autumn harvest and spring planting time.

We had the opportunity to see students working in brigades (groups) preparing the soil for planting. Sometimes twenty students would form a line and turn the soil over with their shovels. In the southern regions of the Soviet Union the plots (gardens) had already been planted and vegetables had begun growing. Students worked in brigades to weed them. They also used the necessary fertilizers and insecticides. A description of a plot is given in chapter II, p. 87.

School production work.—Students in these grade levels receive an introduction to production education and make various useful articles in large quantities. Sometimes the work is devoted to the needs of the school. Kindergarten toys, flower pots, chemistry

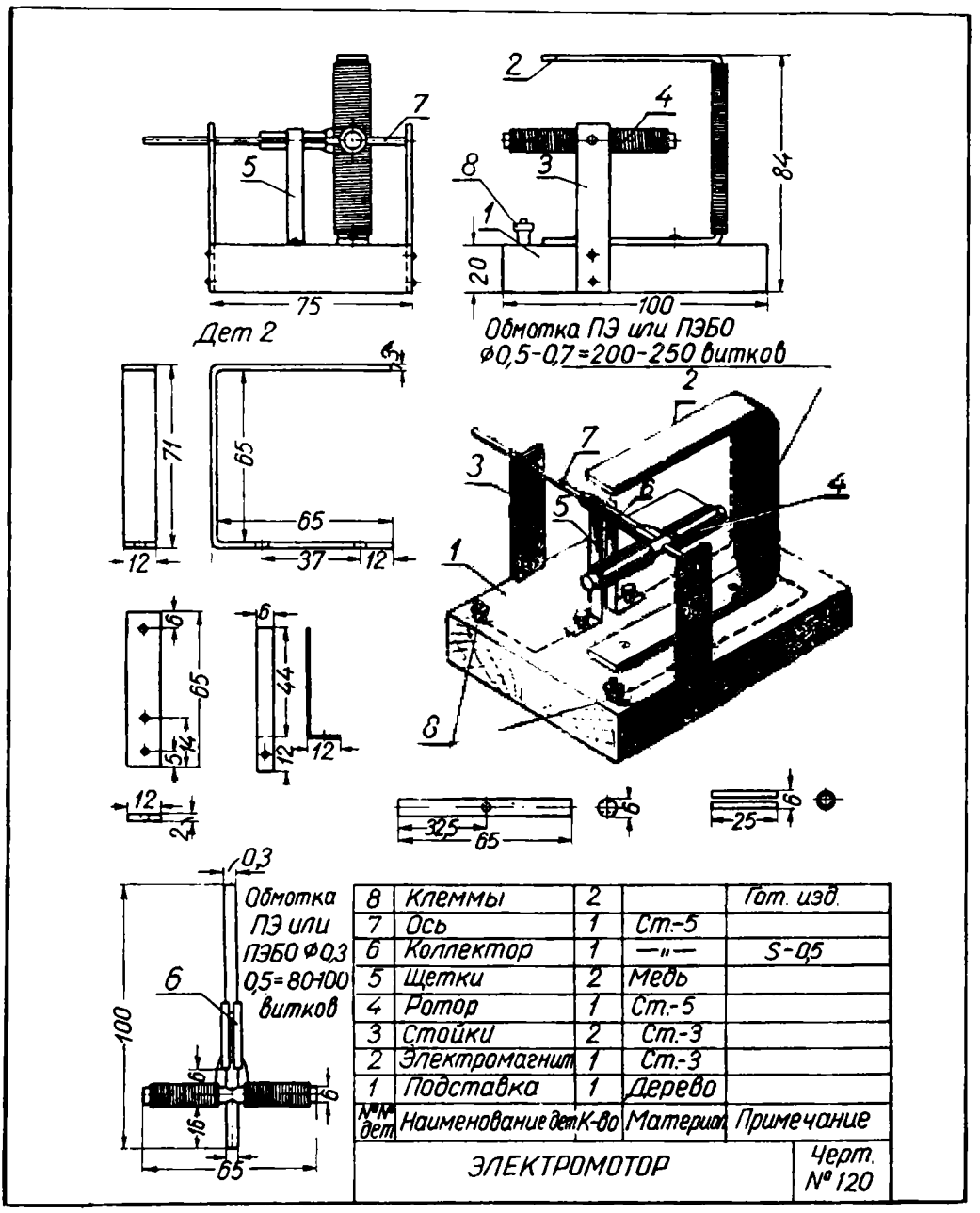


Figure 3-10.—Electric motor.

tray boxes, test tube holders, and hooks, as well as other useful items, have been produced by the student.

Soviet educators emphasize that this production education is very important and that the student should see the results of his labor, both in the form of a well-made article and in remuneration. They also feel a student's attitude improves when he realizes his work has value. Schools work cooperatively with industrial plants in this phase of the instructional program. The plants provide

the materials that the students use to learn about production methods and to get a beginning concept of mass production.

In a boarding school in Moscow, one of the new type schools in the Soviet Union, we were told the labor training is carried out in two ways: (1) Through self-service and (2) through productive labor.

Self-service means that students make their own beds, clean the dormitory rooms, take turns serving and doing jobs in the cafeteria, and in general take care of themselves.

Productive labor is taught through participation in live production work. We saw sixth graders (boys and girls) making paper boxes from cardboard sent to the school from a factory. The finished boxes were used to pack toys at the factory. During the 1957–58 school year this school made 70,000 boxes. The students had work stations where certain operations were performed, and all students learned all the processes over a period of time. Fig. 3-12 shows a girl operating a stapler to fasten the box sides together.

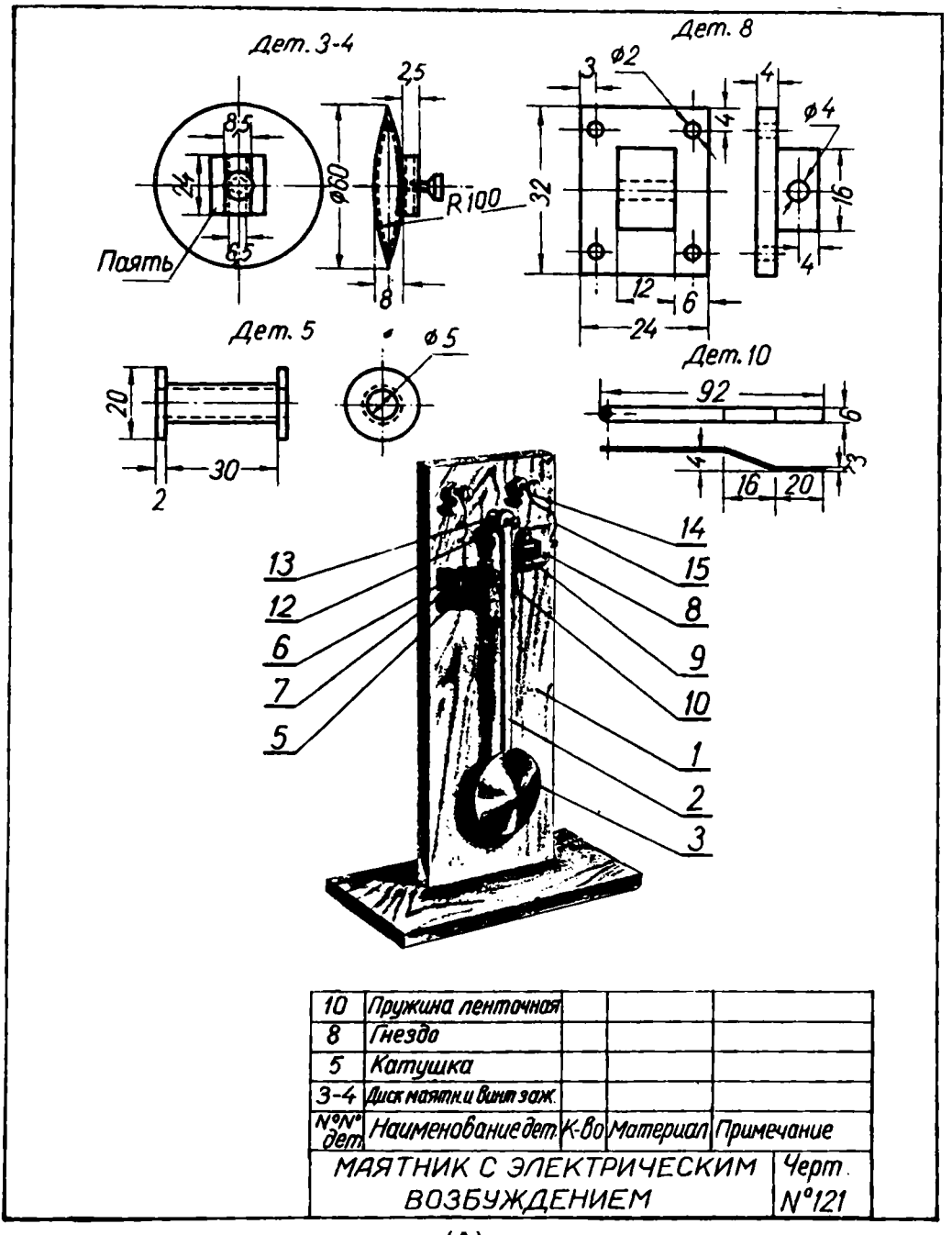
In a sewing class in this same school, girls were making small geology bags. The students receive from 5 to 9 kopeks (approximately ½ to 1 cent) for each bag. The girls had completed 6,000 of the 20,000 bags they were supposed to make. Not all the girls were working on the production job; some were working on individual projects—useful articles for themselves. Dresses, needlework, embroideries, aprons, dress patterns, skirts, and blouses are examples of articles made by students in the sewing classes. (See fig. 3-13.) Also refer to fig. 3-9B, which shows samples of student's work.

We also saw in the school workshop 6 sixth-grade boys making wood shelf brackets. They make 250 a month. On another production job each student made from 10 to 15 wooden screwdriver handles in one hour. Some of the money the pupils receive for such work is turned in to the school to purchase items needed. Last year the value of the students' work was 150,000 rubles. The students received for themselves 90,000 rubles for their part in the production labor.

In a rural school in Russia, students raised 1,000 rabbits and gave them to the State. At the time we visited the school they still had 129 rabbits in a building near the school.

FUNDAMENTALS OF PRODUCTION IN GRADES 8 THROUGH 10

The primary aim of these grades is to give students a basic understanding of modern production and its main branches. The

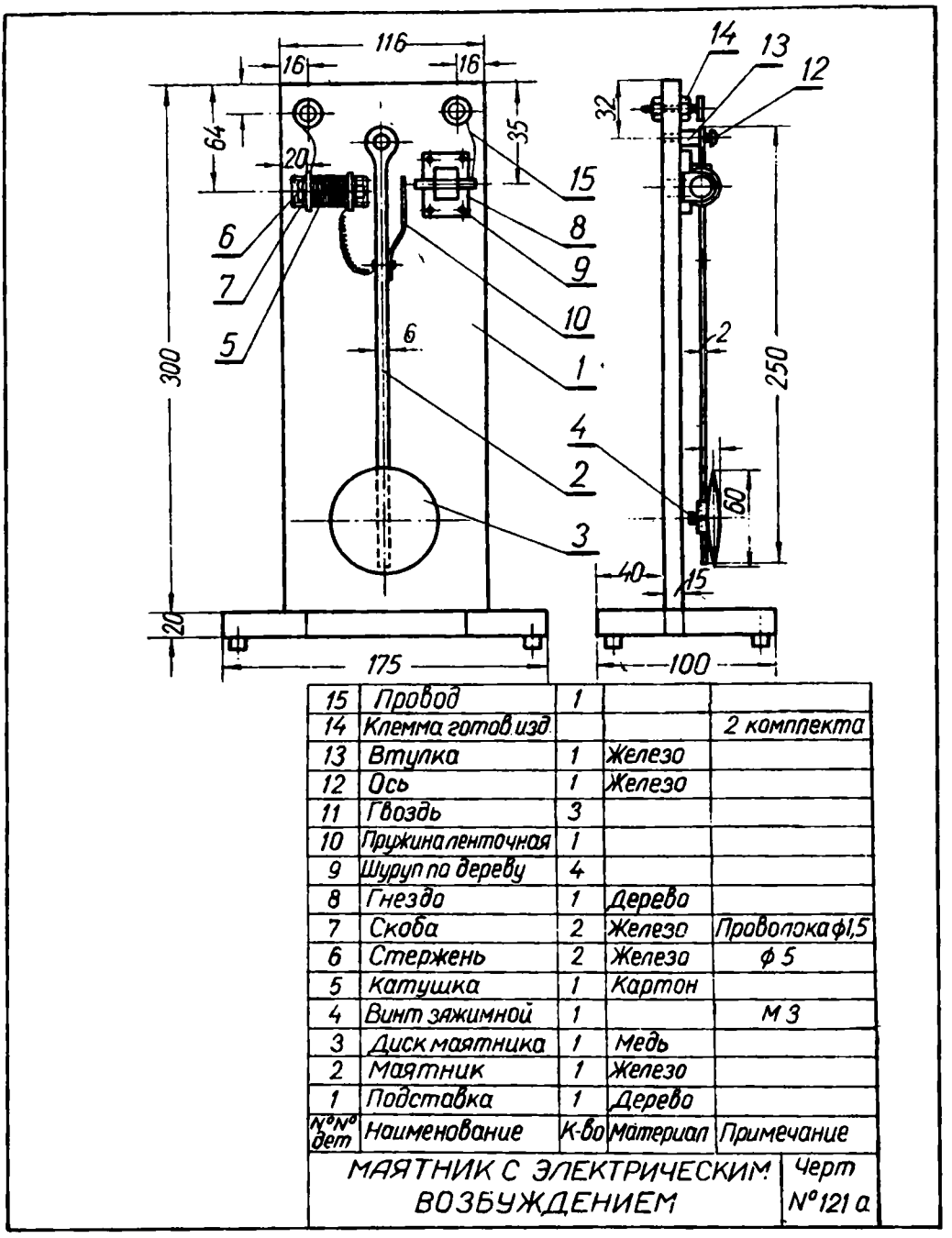


(A)

Figure 3-11.—Pendulum controlled by electrical excitation.

main branches of production, according to Soviet educators, are (1) mechanical production of different materials and products, (2) chemical production, (3) agricultural production, and (4) energy production (particularly electrical energy).

In grades 8 through 10 of the 10-year school, students in urban schools study *fundamentals of production* and do practical productive work. In the ninth grade they study machines and



15	Провод	1		
14	Клемма готов изд			2 комплекта
13	Втулка	1	Железо	
12	Ось	1	Железо	
11	Гвоздь	3		
10	Пружина ленточная	1		
9	Шуруп по дереву	4		
8	Гнездо	1	Дерево	
7	Скоба	2	Железо	Проволока ф1,5
6	Стержень	2	Железо	ф 5
5	Катушка	1	Картон	
4	Винт зажимной	1		М 3
3	Диск маятника	1	Медь	
2	Маятник	1	Железо	
1	Подставка	1	Дерево	
№№ дет	Наименование	К-во	Материал	Примечание

МАЯТНИК С ЭЛЕКТРИЧЕСКИМ ВОЗБУЖДЕНИЕМ | Черт №121 а

(B)

Figure 3-11.—Pendulum controlled by electrical excitation.

industrial production in a specific enterprise. The first half of the 10th grade is devoted to electrotechnics and the last half to automobile work. On passing from grade 8 to 9, pupils spend several days during the summer months in agricultural practice on a State farm, and on passing from grade 9 to 10 they spend time in an industrial enterprise.

In rural schools, students in grades 8 through 10 study

fundamentals of agricultural production and do practical work in plant growing, animal husbandry, the use and operation of agricultural machinery, and the tractor. Between grades 8 and 9 and 9 and 10, students spend several days in the summer on State farms and in grades 9 and 10 students work during the harvest periods.

Although technical drawing actually begins in grade 7 and continues through grade 10, it is all treated here under grades 8 through 10 for convenience in reporting. Both urban and rural students (boys and girls) are required to take technical drawing.

Technical drawing (grades 7 through 10).—By the time students take technical drawing in the upper grades, they already have a background in elementary drawing. Technical drawings in the upper grades are based on a series of models made of wood in various shapes. Some models resemble geometric forms and others, parts of machines. Different grade levels have sets of

Figure 3-12.—Girl stapling a paper box in a school production job.

Figure 3-13.—Seventh graders in sewing class.

these, and in each succeeding grade level the models are more complicated. The student is expected to draw projections of the models. Auxiliary, perspective, and orthographic projections are a part of these courses. In the 10th grade, students are required to draw part of an industrial assembly drawing as one of the last requirements. We observed a 10th grade drawing class in which students were in the process of completing their assembly drawings.

The student must also know how to read technical drawings. Fig. 3-14 shows a typical drawing, and the following questions which students were expected to answer refer to this particular drawing:[4]

1. What is the name of the part which is shown in the drawing, what metal is it made from, and how many projections are shown on the drawing?
2. Give the dimensions of the parts.
3. What is the thickness of the flange?
4. How many through cylindrical holes are in the model, and what are the diameters of the cylindrical openings and the radii of the curves on the object?

[4] S. M. Kulikov, *Chtenie i vypolnenie chertezhei v proektsiiakh.* (Reading and performance of technical drawings in projections.) Moscow, Gos. ucheb. ped. izdat., 1959. P. 140.

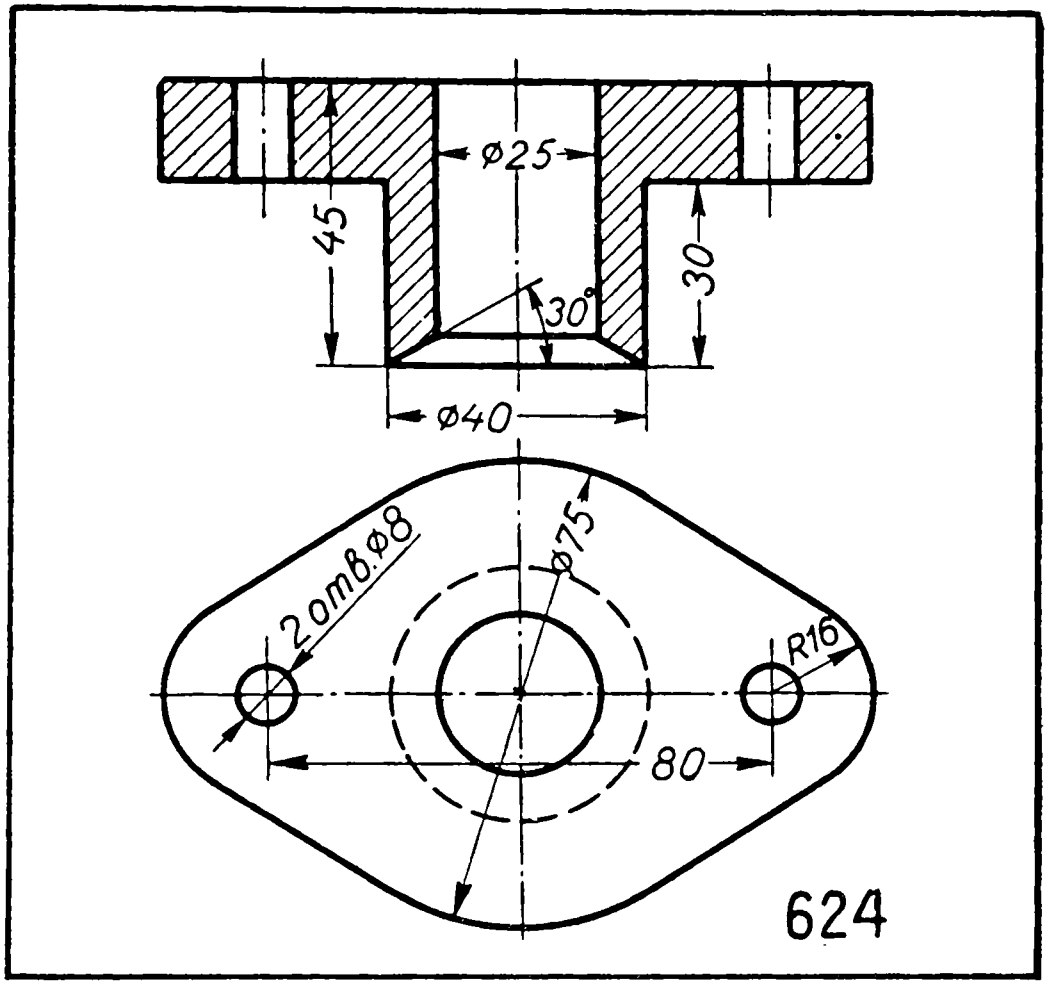


Figure 3-14.—An example of a problem in "how to read a technical drawing." (Refer to questions in text.)

5. What is the distance between the axis of side openings?
6. Determine the wall thickness of the cylindrical part.
7. Plot three projections: the main view without cross section, the side view with cross section in the plane of symmetry, and the plan view.

Another illustration of a drawing problem is given in fig. 3-15 A and B. The student is asked to study all the isometric sketches and identify which of them could be drawn by a single view in orthographic projection. Also, he must make a drawing of 2 or 3 projections and indicate the structure of the parts, in some cases, by a sectional view or extraction.[5]

Machine study (urban schools, grade 8).—This grade level is devoted to understanding machines, mechanisms, and the elements

[5] *Ibid.*, pp. 107–109.

of technology. Soviet educators consider this course basic to their overall polytechnic program in the senior grades. Students learn the application of the principles of science to machine study. Topics such as machine-building materials and the processes for cutting metals, especially on the lathe, milling machine, and shaper, are studied. (See fig. 3-16.) The parts of machines, nomenclature, gear ratios, how the machines are assembled and how they are installed are important topics for discussion and work.

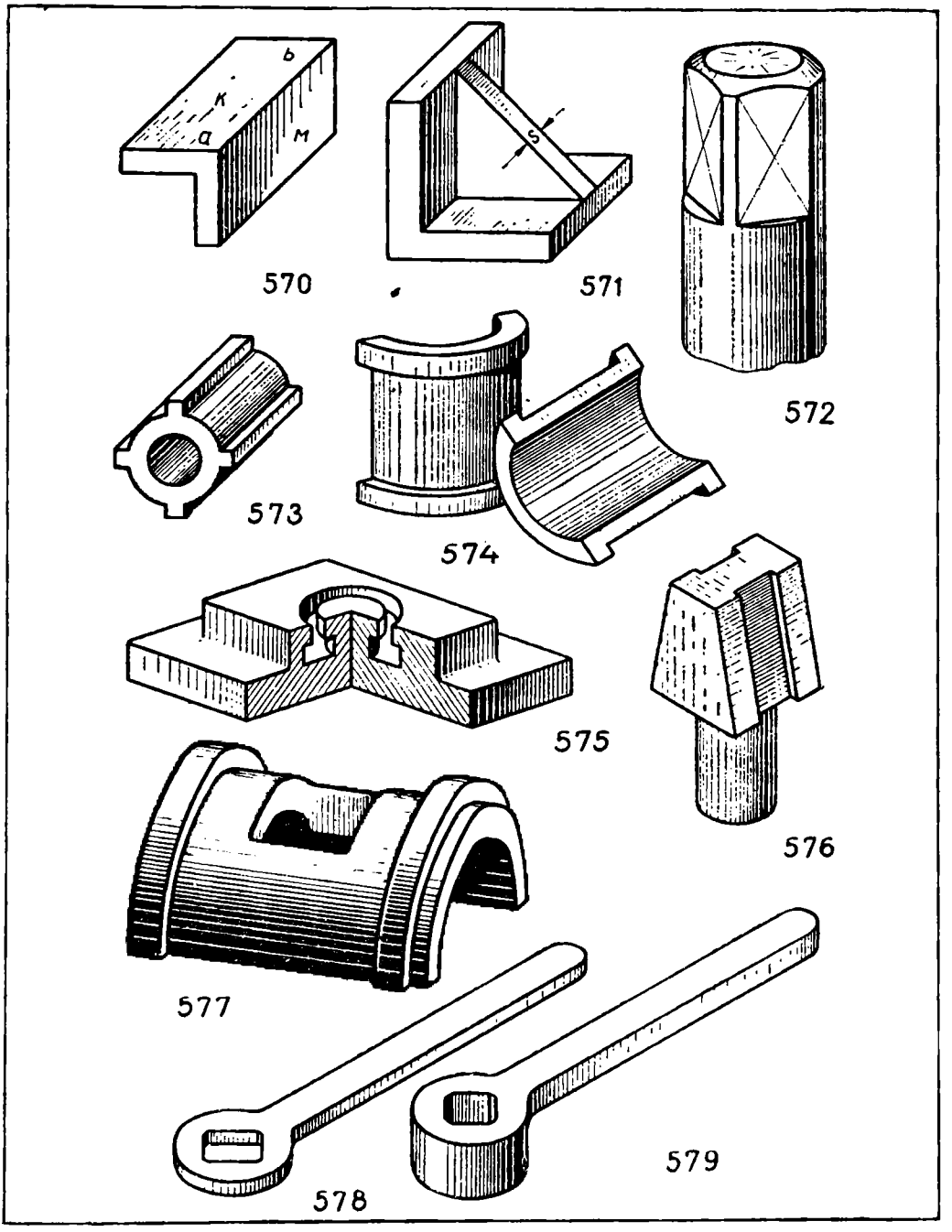
In one school we saw an eighth-grade student working on a lathe making a machine bolt. The machine bolt was not unlike that described in table 7, page 147. The writers asked questions about (1) the number of threads he intended to cut on the bolt, (2) the cutting lubricant he was using, (3) the type of steel, and (4) the names of the parts of the machine he was operating. The student seemed to know the nomenclature of the parts of the machine but had difficulty in answering the first three questions. The teacher had to help him as he attempted to reply. Another student, when asked these same questions, replied to all of them with no difficulty.

Some of the useful articles made in the eighth grade are die wrenches, shafts, wheels, tap wrenches (simple), and hammers. As in the lower grades, production work is carried out, except that now the emphasis is on machine production.

Fundamentals of plant breeding (rural schools, grade 8).—The rural school's polytechnic curriculum varies considerably from that of the urban school's, although there are many elements common to both; for example, both take technical drawing and study machinery. Although the study of machinery and mechanisms in the rural schools pertains to agricultural machinery, the same principles of science as applied to production machinery are taught—transmission of power, gears, levers, etc. Only the application varies.

Eighth-grade students study both fundamentals of plant growing and agricultural machinery. Topics such as conditions of growth, soil, its properties and mineral feeding, rotation of crops, and organization of production and labor on a collective farm are taught. Productive practice during the summer is required when students pass from grade 8 to 9, and also during the harvest period.

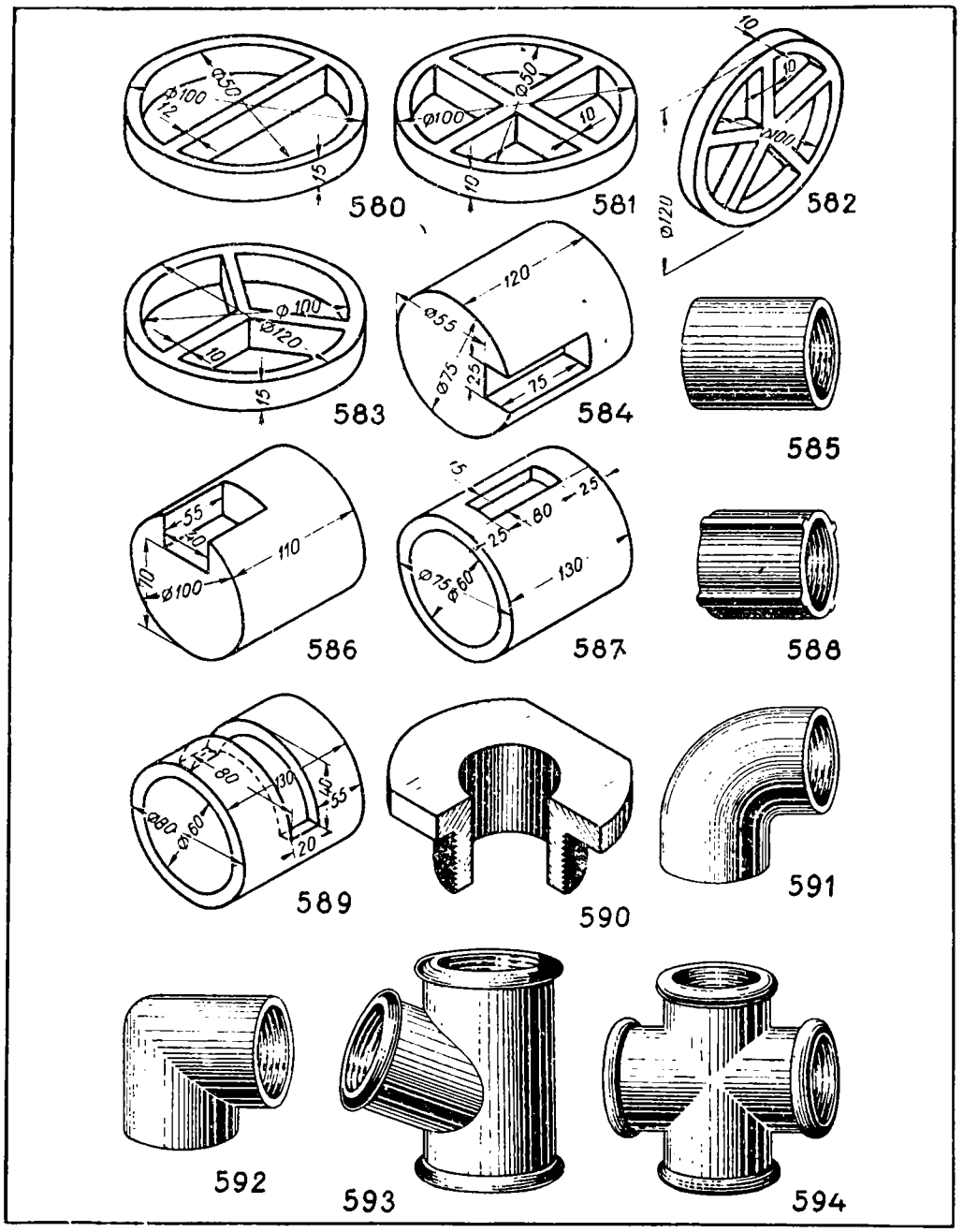
The study and practical work in agricultural machinery is split between the eighth and ninth grades. The eighth grade, for example, takes up plows, harrows, and sowing machines;



(A)

Figure 3-15.—Determining the number of projections needed to make a drawing of each object—a problem in technical drawing.

No. 570, corner iron; No. 571, corner iron with inflexible rib; No. 572, end of cylindrical rod with squares for using wrench; No. 573, bushing with longitudinal rib; No. 574, half of bearing bushing; No. 575, plate of turning vise; No. 576, wedge of jaw for slide valve; No. 577, half of bearing bushing with outlet for oiling; No. 578, handle of wrench (closed, light); No. 579, handle of wrench (closed, heavy).



(B)

Figure 3-15.—Continued.

No. 580, ring with a spoke-rib; No. 581, ring with four spoke-ribs; No. 582, ring with five spoke-ribs; No. 583, ring with three spoke-ribs; No. 584, shaft with key bed; No. 585, muff coupling with thread; No. 586, shaft with lengthwise key bed; No. 587, bushing with lengthwise opening; No. 588, muff with thread and longitudinal ribs; No. 589, bushing with cross sectional openings; No. 590, bushing with thread, made to be used by wrench; No. 591, elbow with thread (curved); No. 592, elbow 90° with thread; No. 593, T-pipe-sloping with thread; and No. 594, cross pipe with thread.

Figure 3-16.—Eighth grader studying machines.

the ninth grade studies and does practical work on harvesting machines for grain, potatoes, flax, beets, and corn. (See appendix IV.)

Fundamentals of industrial production in the form of a specific enterprise (urban schools, grade 9).—With the exception of summer practice, previous production training dealt for the most part with school production work and students participated actively during and after school hours. During grade 9 students get acquainted with a specific industrial enterprise and spend some time in production practice during the year at the plant or building occupied by the enterprise. The 10-year school program calls for 4 hours per week devoted to the fundamentals of industrial production in a specific enterprise. (See appendix I, table B, and appendix IV.)

General acquaintance with the specific enterprise involves studying topics like the production branch in the factory, raw materials used by the plant, technology and techniques of production, and how power is obtained for the plant. Actual participation in productive practice in the main and auxiliary shops is a planned activity worked out by the plant officials and the school's director or coordinator. Each student is assigned

to a machine and works under the supervision of a worker. They work as turners, drill operators, etc. We were told the ninth-grade student can choose the plant in which he wants to get experience. Thus, he can follow his "bent." For example, if he is interested in radio work he can work in a radio-building plant.

As an example of this *work experience education program,* our study team had the opportunity to visit the "Red Proletariat" (Krasnyi Proletarii), a machine-building plant in Moscow, to observe students at work. This particular factory has been given the "Order of Lenin" for its superior work in machine tool manufacturing. Since 1957, they have been producing a metal cutting lathe for exportation to various countries. They produce about 1,000 lathes per month. They also produce tractor parts, railroad wheels, and special machines for polishing. Approximately one-half of the factory workers have at least 15 years experience, and most workers are highly qualified.

In 1936 this plant became "patron" to School No. 16 in Moscow, and helped the school in various ways, such as giving it machines and tools for workshops. In these early years this factory also helped the school in its Pioneer work and extracurricular activities. Since 1953, they have helped the school in production training activities in labor education. Through the efforts of the Ministry of Education, the factory, and the school, the first cooperative plan began in 1953. Three engineers were appointed to help the school with labor training in grades 5, 6, and 7. The engineers worked at the plant and taught school 3 or 4 hours a week in the school workshops, teaching students how to build simple tools, work in wood in the sixth grade, and in metal in the seventh grade.

In 1955 the Ministry of Education introduced the first labor program, sending skilled workers into the schools rather than the engineers they sent in 1953. Teaching guides were prepared to help workers teach. They were released from factory work in the morning to teach in the schools once a week for 3 or 4 hours. Whenever foremen or workers teach in school they get their pay from their regular factory work plus an hourly wage for teaching. We were told some of the workers receive 9 rubles an hour for teaching.

In School No. 16 engineers and teachers of the school worked cooperatively in making out the curriculum for courses in fundamentals of machinery, fundamentals of production, electrotechnics, and automobiles. In the 8th grade, students in this school work in school workshops. In grade 9, they take classes in theory and make excursions to industrial plants. These theory

courses pertain to the tools of the factory and the technological processes involved. In general, the 9th grade polytechnic course is an orientation program and in each of the different schools is implemented by a particular plant.

We were given the titles of some of the theoretical work that takes place prior to actual work in the plant. For example, the students must study such topics as introduction to, and history of, milling machines; materials used at the plant; how to read technical drawings and blueprints; measuring tools (delicate types), tolerance, and standards; administration and management of the plant; and technology of metals, including casting, forging, cutting, assembling, and welding.

After the theoretical instruction given in the school, students spend 1½ months of work experience at the plant for 4 hours a day, six days a week. At the end of this period, they take an examination. For the group we saw in the factory, the test was scheduled June 27. This organizational plan is different from that previously mentioned (4 hours per week for the school year), since School No. 16 is an experimental school.

During this work experience in the ninth grade, students keep a record book of what they do, a daily account of their experiences. As a final project they have to draw the part they were making or assembling; a mark is given on this project. A mark is also given for their practical work at the plant. At the end of their work experience, they write a report. These essays are corrected by the literature teacher. We were told that as a result the literature teachers had to learn technical names, and some went to the factory to learn about the work. We were also told that the teacher of history now includes references to this plant in her courses.

We had the opportunity to observe several ninth-grade students working in the factory. For example, 3 students were working in the central measurement laboratory, measuring the depth of gear teeth and recording the results. One of the purposes of this work was to determine the variation within the depth of each tooth. Another group of ninth-grade girl students were located at a quality control station in the plant, checking various machine parts against specification drawings. We asked one of the girls to perform a check on the concentricity of a gear blank. She quickly found the specification drawing and inserted the gear blank on a splined mandrel between two centers. She used the gage expertly to check the part. She explained effectively that the tolerance was within the necessary limits as specified in the

drawing. A woman inspector was in charge of the girls and she told me they had two weeks orientation and had been on the job about 1½ months. One of these girls wants to become an engineer.

Another group of students were working on benchwork, fitting keyed washers to a shaft. They first hand filed the key on the washer to make a close fit in the slot of the shaft. After they completed this, they screwed a hexagonal nut on the shaft. The work was then repeated. These students had to use a metal vise to hold the washer during the filing, and several trials were made to determine whether the washer fitted properly in the slot of the shaft. Also, some of the other girls in this shop department were cutting threads on bolts, or operating grinding and drilling machines.

An example of the hours of educational and training experience a student would get if he went into a machine-building plant similar to the one described is given here. This listing is taken from the official 10-year school study program.[6]

Machine Building Plant

Grade 9

(Total 232 hrs., 96 in summertime)

I. General Introduction to Machine Building Plant (36 hrs. total)
   - A. Introduction (2 hrs.)
   - B. Basic materials supply and auxiliary shops (2 hrs.)
   - C. Foundry shops (2 hrs.)
   - D. Storage and forge shop (4 hrs.)
   - E. Heat treatment shops (4 hrs.)
   - F. Bases of the technology of machining (6 hrs.)
   - G. Assembly of industrial equipment (4 hrs.)
   - H. Design and working technology of machine production (4 hrs.)
   - I. Power engineering in production (4 hrs.)
   - J. Organization of production (2 hrs.)
   - K. Safety engineering and industrial sanitation (2 hrs.)

II. Industrial Practice (Total 196 hrs., 96 in summertime; no breakdown given for the work in industrial practice)
   - A. Foundry shops
     1. Production of mold frames
     2. Preparation of core box

[6] Ministry of Education of R.S.F.S.R., *Programmy srednei shkoly na 1958–59 uchebnyi god.* (Syllabuses for secondary school for the 1958-59 school year.) Moscow, Uchpedgiz, 1958. p. 75–80.

B. Storage shops
   1. Making of bins out of rungs for movable and stationary machine tools
C. Mechanical Shops
   1. Planing of surface
   2. Machining of parts in the cartridges
   3. Machining of graded cylinders
   4. Working with drillers
   5. Milling of parts by using cutting machines
D. Assembly and repair shops
   1. Preparation for assembly parts and assembly units
   2. Repairs of simple units
E. Work of inspector and acceptance of ready made parts

When there are no machine-building plants near a school, the school may cooperate with the kind of industrial enterprise available to it. Often, it is possible that several different enterprises are nearby where students can get production experience. In this case, a greater selection or choice is provided for the student to follow his "bent" or interests. The program of studies for 10-year schools during 1958–59 lists several types of enterprises which can be used for this ninth-grade work experience education program. They are as follows:

1. Machine-building plants
2. Metallurgical production (ferrous)
3. Electric machine building and electric equipment making
4. Textile industry
5. Polygraphic (printing) industry
6. Railroad transportation
7. Building construction
8. Production of building materials
9. Fundamentals of joiner's work
10. Fundamentals of mechanical shop
11. Fundamentals of lathe work
12. Fundamentals of milling

Theory and practice are taught within the allocated 232 hours for this type of work in the ninth grade.

Fundamentals of animal husbandry (rural schools, grade 9).— In rural schools, students study and get practical experience in

animal husbandry, instead of in machine-building or other plants. Topics like the physical build of horned cattle, their productivity (meat or milk, or both), care of agricultural animals, milking of cows and accounting of milk obtained, breeding of animals, etc., are taught. See appendix IV for further details as to topics and the number of hours devoted to each. Summer practice is also required of students passing from grade 9 to 10.

The beginning of tractor study is taken up at this grade level, with discussion of the types of engines and the principles involved. Students also study the fuel and cooling systems.

Electrotechnics (grade 10).—Classes in electrotechnics or electroengineering, as they are sometimes called, deal with electric light wiring, measuring instruments, electrical machines and equipment, and production and utilization of electrical power. In one class we saw students working on experiments involving light wiring, meters, motor control, power calculation, generators, automobile electricity, 3- and 4-phase lines, use of electricity, 3-phase motors, magnetic controllers, transformers, radio (one tube grid leak), vacuum tubes, and a two-tube radio. The electrotechnics laboratory is closely connected to the physics course.

In one school the course in the electrotechnics laboratory was optional but will be required in their new building. Another school offered it for 34 weeks. In still another school, in Kiev, the course was just getting started.

Electrotechnics is taught in both rural and urban schools, but there seemed to be more emphasis on battery work in the rural schools. See appendix IV for further details as to topics and the number of hours devoted to each.

Automobiles or tractors (grade 10).—Urban schools study automobiles, and rural schools study tractors. Both tractor and automobile shops have engines mounted on racks for assembly, and disassembly, and testing. Transmission, brake, and steering systems are also mounted for instructional work. Pupils not only learn to drive a car (urban schools) or tractor (rural schools), but study and do work on the cooling, oiling, and ignition systems. (See fig. 3-17.)

In a 10-year rural school we visited, this type of work was optional in the 10th grade. However, it will be required in their new building. In a Moscow boarding school, all students are required to take driver training, and some receive a license in the ninth grade. After a student is 17½ years of age he or she can receive a chauffeur-amateur license.

In one rural school that had considerable equipment to teach

Figure 3-17.—Instruction in automobiles.

tractor study, we watched students start their school tractor, and a girl demonstrated her skill in driving it. She seemed very proficient in the operation of the tractor, driving it with ease.

The automobile and tractor courses are taught in the school shop for one-half a semester and do not go into detailed work on the various mechanisms, such as grinding valves. As with the course in machine study, the application of science and mathematics is taught relative to the automobile and tractor.

In rural schools tractor study begins in the ninth grade as a part of the agricultural machinery study, and in the 10th grade more detailed work is carried on with transmissions, lubricating systems, electrical equipment, steering mechanisms, and safety techniques.

If facilities are not extensive enough to allow for a separate automobile shop, this type of work is taught in the machine study laboratory or mechanics shop, as was the case in School No. 6, Kiev. See appendix IV for further details as to topics and the number of hours devoted to each.

The New Curriculum Reforms

In Soviet attempts to bring the school closer to social and economic features of Soviet life, experiments in the curriculum in the past few years have brought about an even greater empha-

sis on polytechnic and production education than that described previously in this chapter. Selected excerpts from official study plans of the Russian Soviet Federated Socialist Republic (R.S.F.S.R.) show this emphasis. (See table 5) The R.S.F.S.R. is the largest of all Soviet republics and plays a leading role in standardizing the curriculums for all republics.

Table 5 reveals the increase in polytechnic courses in the elementary-secondary school from 1955–56 to the present. The selected courses in Study Plan II were a part of the total curriculum of 50 percent of the schools during the 1958–59 school year in the R.S.F.S.R.

In the Ministry of Education in Moscow, we were told that they previously had 248 schools in the R.S.F.S.R. on special ex-

Table 5. — Selected polytechnic courses

(Two figures in a column under a grade indicate number of hours for each semester)

Study plan	Hours of instruction per week in grades—										
	1	2	3	4	5	6	7	8	9	10	11
1	2	3	4	5	6	7	8	9	10	11	12
STUDY PLAN I [1]											
(10-year school, 1955–56)											
Drawing	1	1	1	1	1	1					
Technical drawing							1	1	1	1	
Work and practical exercises	1	1	1	1	2	2	2				
Practicum in agriculture and machine technology and electro-technology								2	2	2	
TOTAL, 1955–56	2	2	2	2	3	3	3	3	3	3	
STUDY PLAN II [2]											
(10-year school, 1957–58)											
Drawing	1	1	1	1	1	1					
Technical drawing							1	1	1	1	
Work and practical Exercises	1	1	2	2	2	2	2				
Fundamentals of production								3	4	4	
TOTAL, 1957–58	2	2	3	3	3	3	3	4	5	5	
STUDY PLAN III [3]											
(11-year school, (1958–59)											
Drawing	1	1	1	1	1	1					
Technical drawing							1	1	2		
Practical work	1	1	2	2	2	2	2				
Principles of industrial production								3	2	0–2	
Practical and theoretical training in industry (industrial work experience)									6	12	18
TOTAL, 1958–59	2	2	3	3	3	3	3	4	10	12–14	18

[1] See appendix I, table A.

[2] See appendix I, table B.

[3] One of several plans used during 1958–59 in preparation for new curriculums in schools formerly on a 10-year program. The 9–11 grade program has been experimented with in recent years and is reported in S. G. Shapovalenko, *ed. Soedinenie obucheniia s proizvoditel'nym trudom uchashchikhsia Opyt piatidesiati shkol R.S.F.S.R.)* (Combining instruction with productive work of pupils. An experience of fifty schools in the R.S.F.S.R.) Moscow: Academy of Pedagogical Sciences, 1958, p. 198.

perimental programs and now (1959–60) have about 2,000. The experimental plans now in use will not be altered for the 1960–61 school year, and an example of one in use appears in appendix I, table C. The excerpt shown in table 6 is taken from still another plan. Notice that an even greater emphasis is put on polytechnic courses and production training. The first five grades will be on the new plan during the 1959–60 school year, and each year other grades will be using the new curriculum. It is the Ministry's plan that by the beginning of the school year 1965–66 all schools will be on the new program.

The new curriculum reforms call for 8 years of compulsory elementary education and 3 years of optional study in grades 9, 10, and 11. These reforms have increased the compulsory education by one year and will add one year to the upper grades, making a total of 11 years for complete elementary-secondary general education.

Actually the curriculum reforms are in a state of broad experimentation, and each year, no doubt, the curriculums will be revised in the light of the experience gained. Educators in the U.S.S.R. emphasized this aspect because, although the programs are worked out for grades 9, 10, and 11, they will be on probation for the first year or so. The overall aim, however, of these new reforms has been to develop an 11-year elementary-secondary general polytechnic school.

CONCEPTS, PURPOSE, AND IMPLEMENTATION OF THE POLYTECHNIC REFORMS

To have all pupils combine academic work with practical work

Table 6.—Selected courses from study plan of 8-year and secondary school (urban) with production training[1]

Course	Hours of instruction per week in grades —										
	1	2	3	4	5	6	7	8	9	10	11
1	2	3	4	5	6	7	8	9	10	11	12
Drawing	1	1	1	1	1	1	1				
Technical drawing							1	1	2		
Labor instruction	2	2	2	2	3	3	3	3			
Socially-useful work			2	2	2	2	2	2			
Socially-productive practice (2 weeks each at end of the school semester, grades 5–8)											
General technical subjects, production (theoretical and practical) instruction, and productive labor									12	12	12
TOTAL	3	3	5	5	6	6	7	6	14	12	12

[1] See appendix II, tables E and F, and for variations in rural schools, table G, and other details.

is one of the primary purposes of the new reforms. This plan is an ambitious one, and Soviet educators are striving to realize it fully by 1965. Their belief in this combined educational program was characterized by a statement by the Director of the Institute of Theory and History of Pedagogy, when he said, "We are optimistic here . . . Our aim is to combine manual work with knowledge . . . this is a real human existence." Soviet educators believe that all normal persons can be "prepared from all sides" and that the school should strengthen the link to life and work. It is difficult, they say, for a youngster 15 years of age to make his own decisions to prepare for either college or work. And, they emphasize that education has value when manual labor is combined with intellectual work.

More specific aims of the reforms are: (1) To improve further general and polytechnic education, (2) to lessen the academic load on students, (3) to provide opportunity for higher education to all workers, (4) to increase production education (theoretical and practical) so that students can do productive labor in industrial and agricultural enterprises, (5) to provide for more physical and moral education, and (6) to add more mathematics and science, at the same time making their teaching more effective.

A leading researcher in the Institute of Teaching Methods and Chairman of its Section of Polytechnic Education explained that the 10-year general school program has already a polytechnic education program in grades 1–10. As an illustration, students in these grades study fundamentals of machines, get acquainted with the notions of industry, and do some industrial practice at an enterprise. They also are required to take courses in electrotechnics, and automobiles or tractors. These courses are considered as polytechnic, and *not* vocational.

He further told us that in the 11-year program all the nonvocational polytechnic education of the 10-year school will be preserved, but the new program will have 1,000 hours of vocational training. Theory and practice will be included within the 1,000 hours.

The overall aim of polytechnic education is to give all-around general education, while production training is a supplementary aim. The students who graduate in the new program are qualified *workers,* not technicians or specialists, they say. Furthermore, we were told that if a student upon graduation has learned a certain specialty, such as *fitter,* it does not mean that he will remain a fitter.

Worker specialties.—A worker's specialty is the job classification in a particular industrial or agricultural field. For example, specialties in various fields are: Assembly mechanic, mechanic, machinist, seamstress, typist, laboratory worker, lathe operator, draftsman, machinist and motorist, layout man, cattle breeder, tractor driver, fruit grower, and various mechanics with a wide field of experience. We were told that the worker specialties are now being developed for both the 8-year school (followed by vocational-technical programs) and the 11-year general school.

In one 11-year school in Leningrad they train for 10 specialties. These are: (1) Metalworkers, general, (2) assemblers, (3) tool makers, (4) fitters, repairmen, (5) drilling and milling machine tool operators, (6) carpenters, (7) patternmakers, (8) layout men, (9) industrial motor electricians, and (10) instrument men (electric meters). Different schools train for different specialties depending on the industrial enterprises available for the production training.

Proficiency degree.—Those students engaged in production training in the new program in the factory take a qualification test near the end of the 10th grade for a *proficiency degree.* This degree is indicative of the skill the student possesses in his specialty at the time he takes the test. Proficiency degrees are identified by numbers 1 through 8. Number 1 is the lowest, and 8 the highest. We were told that a number 1 rating does not actually exist as a proficiency rating but rather as a reference point.

In one city, during the 3 days a week work experience in industry prior to receiving a proficiency rating, students were were paid 150 rubles per month and were considered to be apprentices. In another city, the pay received during a similar period ranged from 240 to 270 rubles per month, and the pay was called a *stipend.* It was pointed out to us that the stipend was not really pay, since this work was considered a chance for the student to get his professional experience and the money paid for his food and transportation to and from the enterprise.

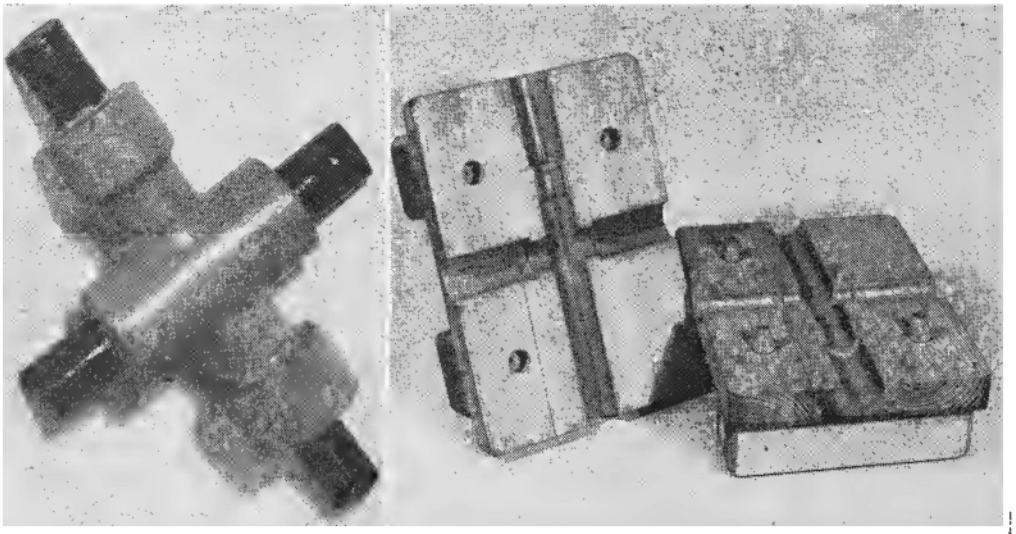
After students pass their qualification test they receive a proficiency degree, for example, of 3, and then they receive a regular worker's wage and a plan of work which they must fulfill. A proficiency degree rating of 3 is usually given to a beginner, but some do get a higher rating. A worker who holds a proficiency rating of 3 can get from 450–600 rubles a month for working 6 days a week.

The production training period in the 11th grade is to allow

the student to increase his skill and experience as a production worker, and some get a number 4 proficiency degree by passing another qualification test. We were told it would normally take 2 or 3 years of work after graduation to obtain a proficiency degree of 7. Regular lathe operators in the plant we visited had proficiency degrees of 4 and 5. Fig. 3–18 shows an example of the work expected of a student with a proficiency degree of 4.

Soviet educators do not consider that students in the 10-year program are qualified workers since a 10-year school does not include enough production training. Nor do students, as a rule, get a proficiency degree in a job classification such as they obtain in the 11-year school. The 11-year school may be terminal for some students, we were told, but it is not intended to be so. Even though much more polytechnic education has been added in the 11-year program, Soviet educators feel that other subjects have been strengthened, not slighted. In experimental programs they find that students grow fond of the enterprises where they work.

One of the most significant changes in the new curriculum reforms is an increase in the number of hours of production training in industry. This *work experience education program,* with its planned curriculum, organized cooperatively by school and industry officials, is being extended through the 10th and 11th grades. The new plan calls for increased hours for this work experience at grades 9, 10, and 11.



(A) (B)

Figure 3-18.—An example of a student's work in patternmaking; A—pattern, B—core box.

CURRICULUM CHANGES

The basic change in implementing the new curriculum reforms is the dual character of the general schools. All students, upon graduating from the 11-year program, are expected to have basic academic background sufficient for college entrance and also be qualified workers in either industry or agriculture.

Changes in grades 1–8.—The new curriculum plan increases considerably the amount of time that boys and girls will spend in polytechnic subjects. The girls will be taking more domestic science in grades 5–8. In both the old and new programs we saw, domestic science classes consisted mostly of sewing, although cooking is being developed. In the new 8-year school, boys will continue to take woodworking while girls take sewing.

Changes in the upper grades (9–11).—Grade 9, as in the 10-year school program, is an orientation period. However, in the new curriculum, 12 hours a week, rather than 4 hours, are devoted in grade 9 to the fundamentals of production. Grades 10 and 11 also have 12 hours required. See appendix II, tables E, F, and G for details and variations of urban and rural schools.

At the time we visited Soviet schools, some schools were in a transitional period where one or more classes were in the experimental program. In 11-year School No. 4 in Leningrad, the students in the 10th grade had the choice of studying in this school and working at the plant to master a specialty or of going to another 10-year school. Soviet educators are considering means to assist students who wish to shift from one school to another. The student who wishes to study a specialty must make his decision in the first 2 or 3 months of the 10th grade as to whether he or she likes the specialty.

Work experience.—During the 10th grade production training in industry, the student pursuing the specialty of drilling and milling machines, would first do the simplest things and then work up to the complicated machines later. For example, he would get experience for the first 2 months on very simple metal parts, such as filing and doing simple drilling operations. For the next 2 to 3 months he would get experience on actual production work, and for the rest of the year he would get experience on the more complicated automatic machines. At the end of this work, we were told, he would be on the "automatic line." Theoretical instruction such as technology of metals, structure and operation of tools, reading technical drawings, safety techniques, and the organization of production also is taught to them.

At the Red Proletariat, the machine-building plant, we had the

opportunity to observe 10th-grade students at work. One of the students was working as a *fitter, assembler,* doing a scraping job on two machined surfaces of a lathe tail stock so as to make a good fit. We asked him to sharpen his tools and perform the scraping operation. He did so skillfully. This student worker had been in this department in the plant during his 10th grade production training and had achieved a proficiency degree of 4.

Another 10th-grade student worker was assembling a turret head for a lathe. His work involved selecting a center post for the turret head and testing its fit. When he was satisfied with the fit, he drilled and tapped a hole for a set screw. The set screw acted as a locking pin. He also had a proficiency degree of 4.

We also observed a student assembling parts on a large motor. He was working alone following the specifications on a blueprint. He too had a proficiency rating of 4. During our discussion with him he showed us a metal hacksaw and hammer he had made at the plant. Two 10th grade girls were working as electricians. Their job was to make a graph on the characteristics of a motor which was under test. Each of them was examining data sheets on the motor. These students were working under the direct supervision of an engineer at the plant. The engineer acts as a tutor, and each girl also was assigned to a qualified worker. They were receiving 150 rubles a month and had a proficiency degree of 3. The girls told us they had repaired switchboard instruments, controllers, wound coils for meters, and visited other plants previous to this particular work.

During the 11th grade in the new curriculum the students have the opportunity to increase their skill in their particular specialty. We were told that in January the 11th graders can take another qualifying test to increase their proficiency rating. During the time we visited the Soviet Union, the 11th graders had returned to attend full-time classes at school, after the qualifying test in January, and were preparing for their maturity examinations.

POLYTECHNIC EDUCATION AND SOVIET VOCATIONAL EDUCATION

Although the purpose of our study did not include vocational education, we were nevertheless interested to learn about the relationships, if any, that polytechnic education may have to Soviet vocational education. In discussing this matter, we encountered varying opinions from Soviet educators. The following statements represent almost word-for-word comments made to us

during our visit by various Soviet educators concerning this aspect of their 10- and 11-year general school program:

1. The vocational school is based on graduates from the new 8-year compulsory school. In the future there will be no trade schools but rather vocational-technical schools.
2. Polytechnic education is not vocational work—not quite, it is polytechnic.[7]
3. To some degree polytechnic education is vocational education. The main difference is that students get practical work and theory in the general education schools. Vocational schools have practical training 6 days a week.
4. The manipulative and technical education is about the same in the 11-year school and vocational-technical school, but the difference is in the general education. Science and technology are heavy in the 11-year general school.
5. Three years ago this school became experimental, dealing with production education. It is not vocational education, but pupils do get an understanding of production.
6. A vocational program is narrow. In a one-year vocational program the student can get a specialty (e.g., tractor driver), but he cannot get a maturity diploma.
7. Vocational training is a part of polytechnic education.
8. Labor production done in school is not vocational education.
9. Instruction in electrotechnics and machine study is not vocational education.
10. We are not certain as to what might happen to the present vocational schools.
11. School production work is not necessarily vocational education. It depends on whether the student wants to try to qualify for a special working degree.

Some of the foregoing comments tend to sound contradictory and indicate to some degree that Soviet educators are still discussing and formulating their concepts regarding polytechnic education and its relationships to Soviet vocational education. Clarification of the philosophy and purpose of polytechnic education for Soviet administrators and teachers would seem to be necessary for the successful implementation of the polytechnic educational program. The immediate burden of solving this problem has been apparently thrust, for the most part, upon the inservice training institutions.

We had the opportunity to visit one vocational school, No. 5, at Tbilisi in the Georgian Republic. This school takes only boys,

[7] We understand this statement to mean that in the U.S.S.R. polytechnic training is definitely broader than vocational training.

ages 14 or 15. It is called a "special school" because only students of parents who fought in the "Great Patriotic War" (World War II) can attend. That is the only reason, we were told, it is called a special school. The school prepares metalworkers with proficiency degrees of 4 or 5.

It is a 4-year school, and it normally takes graduates from the 7-year general school. General courses such as physics, chemistry, foreign languages, etc., are taught. English is an obligatory subject. We were told that the students' *general* education at the time they graduate from the vocational school is equivalent to that of the *ninth grade* in the 10-year general school program.

We visited some of the classes and observed students working on parts for a drill press that the school manufactures. The equipment was much more extensive than in the general education schools. For example, one room had over 20 metalworking lathes, and students were machining small parts for the drill press, such as nuts, sleeves, valves, washers, bolts, and pulleys. A mechanical shop had a large planer, shaper, O.D. grinder, gear cutter, two milling machines, and a boring machine. One milling machine was an old *Cincinnati,* an American built machine. In the assembly room, we saw students assembling drill presses. We also saw a first-year class making a small metal wrench by cutting and hand filing.

The plan of organization is to have alternate days of practical work in the shops and theoretical work in the classrooms—one-half of the students are in the shops, and the other half take theoretical and general studies. The last term of the 4 years is spent in a factory. The plan of study for this school was given to us at the time we visited it. (See appendix V.)

Organization and Operation of School Workshops and Production Training

In Leningrad there are 460 secondary schools in the city, with 170 of them operating on experimental programs, according to information given us. Sixteen of these schools specialized in patternmaking. We also learned that 271 schools had agricultural plots. In Kiev, we learned that one of their most pressing problems was building new schools. They were planning to build 13 to 15 new schools each year. As we visited different schools we learned that the facilities and equipment for polytechnic education varied from school to school. Some workshops were much better equipped to carry on this type of work than others. All

schools, however, planned their curriculum according to the program from their Ministry of Education. This program is obligatory, except where the school does not have facilities to conduct the work. It is now a law, we were told, that all enterprises must give their old equipment to school shops. As a result of this law, school No. 6 in Kiev, for example, will now have a "patron" factory. Although most of the schools we visited contained 10 or 11 grades in one building, we were told that in the future they may have grades 9, 10, and 11 in a separate building. This separate building would be for general education purposes. One Soviet educator made the comment that it might prove to be more economical to set up special workshops in factories than in schools.

BUDGETS FOR POLYTECHNIC EDUCATION

Although we did not collect statistics on overall school budgets nor attempt to analyze this problem, some data on financing the new program indicate the emphasis on it. School No. 6, Kiev, with 723 students and 53 teachers, operates on a total budget of 1 million rubles. This figure does not include salaries. Two workshops in the school get an allocation of 50,000 rubles per year. Students do not pay for anything they make and at the end of the year can take the individual personal articles home.

At a 7-year school in Zagorsk, Russia, they are now building new workshops. Their patron factory, a brick and a paint factory, donated 30,000 rubles to them for their workshop equipment. A new physics laboratory is also being built. This school will soon have 8 grades under the new curriculum. It was pointed out that the parents' committee of the school helped them acquire needed items, and the students themselves "do things with their own hands." For example, the students built their own play yard, and fertilized and planted 100 shrubs as well as many trees and flowers on the school grounds. Students' productive labor at the school is another means by which funds are made available to the school.

DESCRIPTION OF WORKSHOPS AND WORKSHOP EQUIPMENT

Special school facilities for polytechnic education begin at the 5th-grade level. In grades 5 to 8, special workshops for woodworking, metalworking, and fundamentals of machines are designed. For the upper grades, 9, 10, and 11, special facilities are used for electrotechnics, and automobile or tractor study. A description of the garden plots is given in chapter II.

Drawing.—Elementary and technical drawing is taught in regular classrooms. In technical drawing classes students place their drawing boards on regular classroom desks. The desks are generally built for two students. Each of the students in a technical drawing class we observed in one school had a drawing set and wooden triangles. There were charts on two sides of the room showing how to hold the pencil, triangles, etc. These charts, for the most part, showed proper techniques in drawing. We observed, however, that some students did not use good drawing techniques. Mounted on the wall, some of the better pencil and ink drawings the students made were also grouped together to form a display. The teacher's desk was at the front of the room, and one or two cabinets were located nearby for equipment, storage of models, etc.

Labor (manual arts) facilities in grades 1-4.—No special facilities were in evidence, during our visit to schools, for this type of training, except hand tools. See the following list of these. Students did this type of work on their own desks. In one elementary class we visited, which was typical, there were 42 seats for students and 38 students in the class. The teacher's desk was in the front of the room, along with a blackboard and bulletin board. There were flower plants on the window sills and two storage cabinets on one side of the room. It was indicated in one school that, in the future, they hoped to have a separate room for this type of work.

Woodworking shop.—This type of shop, often called a joiner's shop, contains the basic hand tools used in woodworking. See list of equipment in appendix VI. For example, in one school we saw 20 woodworking benches; 2 small wood lathes (length of bed 12 inches); 3 wood lathes, full size; a 5-inch joiner; and a large wood lathe. In School No. 14, Zagorsk, we saw 20 woodworking benches; combination saw and joiner; and various hand tools. An example of the woodworking shops we saw is that illustrated in fig. 3-19.

Metalworking shop.—This kind of workshop is commonly known as a mechanic's shop, machine shop, or locksmith's shop. Typical tools and equipment in this shop are eight metal vises, drill press (one large, one small), grinder, large industrial type metal lathe, arbor press, and various hand tools for cutting and filing metal. Another workshop had 20 vises; drill press; small heat-treatment furnace; grinder; hot plate; soldering irons; and various small tools for cutting and working with metal. Appendix VII contains an inventory of the supplies used in the workshops.

Instruments for Working with Paper Cartons and Fabrics [1]	*Quantity*
Ruler	40
Ruler (length, 50 cm.)	20
Knife	5
Triangle, 45°	5
Ruler (length, 25 cm.)	10
Angles	10
Scissors	20
Awls	20
Needles	100
Thimbles	40
Knitting needles	50
Embroidery frames	20
Brushes (paste)	40
Brushes (paint)	30
Steel rule (with groove)	5

Instruments for Working with Paper Cartons and Fabrics	*Quantity*
Knitting hooks	10
Knitting frames	10
Glue pot	2
Glue containers	40
Bookbinder's knife	1
Circle cutter	1
Bookbinding press	1
Sewing frame (book)	1
Bone folders	5
Carton cutter	1
Punches (various sizes)	3
Cutting board	1
Boards for clay modeling	40
Electric plate	1
Double boiler for glue	1

Tools Used in Agriculture for Work on the Plots	*Quantity*
Shovels	40
Rakes	20
Adze	20
Pan (small)	10
Buckets, children's	10
Watering can	10
Baskets	5

Tools Used in Agriculture for Work on the Plots	*Quantity*
Carryall (stretcher type)	2
Boxes for sewing	10
Cords	2
Measuring tape	1
Meter	1
Sifter	1
Corner plates (small)	20

Instruments for Working with Technical Modeling	*Quantity*
Plane	5
Rough plane	5
Hacksaw	5
Special long hacksaw	3
Handsaw	10
Handsaw (for cutting trees)	20
Awl	5
Hammer, carpenter's, 150–250 g.	10
Mallet	10
Cutting chisels	10
Bit	1
Pliers	5
Screwdriver	5
Nippers	5

Instruments for Working with Technical Modeling	*Quantity*
Pliers, flat	5
Pliers, round nose	5
Axe	5
Files, various types	10
Snips	5
Coping saw and blades	5
Honing stone	2
Hand vise	5
Vise (8 cm.)	2
Monkey wrench and others	5
Bit, gimlet	2
Mechanic's tool set (10 tools each)	2
Screw clamps (wood and metal)	5

[1] Ministry of Education of R.S.F.S.R., *Programmy srednei shkoly na 1958/59 uchebnyi god. (Syllabuses for Secondary Schools for 1958–59 school year.) Moscow*, Uchpedgiz, 1958. P. 22–24.

Size of shops.—Both metalworking and woodworking shops are rather small by our standards: Some shops have about 420 square feet (approximately 19 feet by 22 feet), and this size shop accommodates 18 to 20 students. Another common-size shop has about 646 square feet (approximately 19 feet by 33 feet). This shop is designed for 20 to 25 students. Some shops had classrooms close by for theoretical instruction pertaining to their work. An example of the metalworking shop or mechanic's shop is that shown in fig. 3-19. This example shows how equipment is placed in the workshops and its general layout. The auxiliary room located between the two shops (fig. 3-19) is primarily designed for the circular saw and wood planer as well as a teacher preparation room.

Machine study shop.—The study of the fundamentals of machines is sometimes taught in a separate shop providing more lathes and power equipment than that normally found in the metal shop or mechanic's shop. In the 10-year school at Zagorsk, for example, the fundamentals of machine study had the following equipment: 4 metal lathes, 10-inch swing and 4-foot beds; 1 small metal lathe; milling machine (horizontal); grinder; shaper, 6 or 7 inch stroke; height gage; vertical mill; and 1 small lathe (watchmaker's type). The patron factory of this school gave them their old machines. The students with their teacher repaired them to make the machines useful for the school. While we were in the shop, the teacher proudly explained that one of his students had made the feed pump for the milling machine. The teacher also said the students are going to repair five drill presses for the factory.

Sewing rooms.—Rooms used for the sewing classes that we observed were ordinary-size classrooms with 10 to 12 sewing machines, 2 or more large tables for cutting out patterns, and storage cabinets. A blackboard and bulletin board were located in the front of the room. In most sewing rooms, there was an ample display of the articles made by students. The rooms usually had green plants growing in flower pots by the windows, which helped to make the room look attractive. One of the members of the team said he saw as American-make sewing machine on one of the tables in a sewing class. Some of the sewing machines carried German names.

Automobile and tractor shops.—In some schools we saw a large amount of equipment and facilities for teaching automobile or tractor work; in others this subject was taught along with the fundamentals of machine study shop. In one of the schools, the

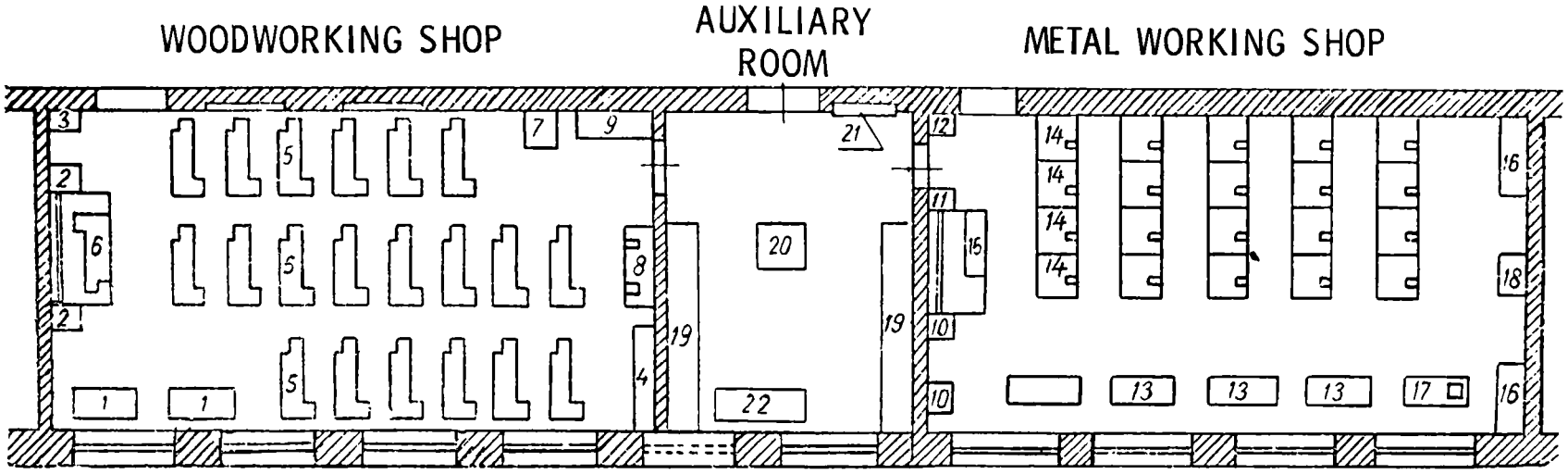


Figure 3-19.—Woodworking (joiner) shop and metalworking (mechanic) shop

1. Turner's lathe (two); 2. driller (two); 3. sharpener (one); 4. tool closets (one); 5. bench for joiner (twenty); 6. bench for teacher (one); 7. wet grinder (one); 8. bench for 2 students—metalwork (one); 9. extra table (one); 10. driller (two); 11. muffel furnace (one); 12. sharpener (one); 13. lathe (two) [sic]; 14. bench for metalworkers (twenty); 15. bench for teacher (one); 16. tool closets (two); 17. extra table (one); 18. table for motion picture camera (one); 19. shelves (two); 20. electric circular saw (one); 21. switchboard (one); and 22. table for teacher (one).

equipment, such as transmissions, steering mechanisms, engines, carburetors, and brakes, was located in a large hallway in the school. Some of the equipment was mounted on portable units that could be moved so students could work around them more easily.

A tractor shop in one rural school had tractor units placed or mounted on small worktables. Different units from tractors included, for example, transmission, steering, engine mockup (gasoline and diesel), cooling system, and fuel system. The room was approximately 18 by 20 feet in size.

Electrotechnic laboratory.—Elementary electricity in the seventh grade is taught within the metal shop with the necessary electrical hand tools, pliers, etc. As mentioned before, this area of instruction was probably the weakest taught and it was reflected by the lack of equipment at these grade levels. Some of the electrotechnic laboratories for the 10th grade were indeed well equipped. However, some schools did not have an electrotechnic laboratory, and one school had just completed building the laboratory. This laboratory had wooden benches with wooden boards for wiring. Each bench had two screwdrivers, 2 pliers, 2 knives, flush type switches and lamp sockets, and knobs (insulated) for circuitry work. They also had a power supply unit, motor, and transformer in the room. Five charts were posted on the wall; one gave an explanation of 3-phase current.

The 10th-grade electrotechnic laboratory in Moscow School No. 16, for example, was quite elaborate. A series of 15 experiments were set up on worktables, with the tables facing one another and a vertical separation between them. On each side of each table was a different experiment. In doing the experiments, the students had used many kinds of equipment, such as wiring devices, electric meters, controllers, transformers, motors, and radio parts. The room was an ordinary-size classroom and could accommodate 18 to 20 students.

ORGANIZATION OF POLYTECHNIC COURSES

Scheduling of classes for polytechnic education is usually arranged so that they can follow one another. For example, when two periods are required per week they are coupled together. If 3 hours a week are scheduled, it is usually taught with all 3 periods following one another on one day of the week.

When classes get too large—for example, 25 students in electrotechnics—they are split into two groups. In workshops where there are only 8 lathes and 16 students, the students are

divided into two groups also. Students are usually rotated every one-half year within the workshops.

In the ninth grade of a 10-year school the students, in one organizational plan, go to an enterprise for 4 hours once a week. The rest of the day students are free to attend technical clubs (circles) or other activities.

Production work of a useful nature used in the workshops for labor training is determined by a factory, or by the needs of the school or other organizations. Students also do individual work according to the prescribed syllabus.

Although we did not see any interschool workshops during our visit, we were told they do exist. These workshops are located centrally, and they serve the needs of two or more schools.

ORGANIZATIONAL PLANS FOR PRODUCTION TRAINING (WORK EXPERIENCE)

All schools on the new curriculum reforms will shift over to a new organizational plan beginning in the ninth grade, and two basic changes in organization occur at grades 10 and 11. First, the academic courses are split in half in grades 10 and 11, one-half in each grade, and second, production training has been increased at the factory in grades 10 and 11.

Coordinating groups.—A good description was given us in Leningrad of the make-up and purpose of a *polytechnic commission.* This group consists of various teachers, in subject areas of mathematics, science, chemistry, and polytechnics, plus representatives from the enterprise where the students get their production training. The representatives from the factory in this group were the assistant chief engineer, and the chief of the school division; in this case the latter was a woman. The vice-director of the 11-year school was chairman of the commission. This commission worked closely with the local *Council of Peoples' Economy,* whose function is to manage certain industrial and economic affairs for that area.

The purpose of the polytechnic commission is to coordinate the school subjects with the technical work at the plant. The specialties for which training will be given are chosen at the plant, and sometimes change yearly. It was pointed out in our discussions that this cooperative effort between industry and the school helps bring the curriculum up to date. They mentioned that, since the school's technical drawing instruction lagged behind instruction at the plant, they upgraded the technical drawing curriculum. Another example, they told us, was that the physics, mathematics, and chemistry courses taught by the school were too theoretical.

With changes in these courses, the students can now better connect the theoretical information with the practical implementation of these disciplines. These changes, they say, have made chemistry and physics instruction more practical, and the student achieves a deeper understanding.

Selection of specialties by students.—An example of how Soviet pupils select their areas of specialization at the secondary school was given us in Leningrad. About 2 weeks before we visited School No. 4 in Leningrad, the director had asked the parents of ninth-grade students to meet with him. He told them of the new plan or organization and the specialties that the plant was to provide. The parents were given two weeks to think it over and help students decide which specialties to elect. Since this school is in a transitional stage, the students had the option of going to another 10-year school that did not offer the new program. Within the specified time, the parents wrote letters to the director of the school indicating their choice for the youngsters. Out of 40 students only 7 did not want to master a specialty. The vice director was in the process of making plans so that these students could work in the plants. In the fall, students will return to school the first day, and then go to the plants the next day to get acquainted.

Schedule for production training (work experience).—When increased production training is introduced in the 1959 school year, students will spend 2 days at the plant and 4 days in school. Under this latter organizational plan students will have 1 day at the plant, 2 days at school, 1 day at the plant, and 2 days at the school. They feel this plan will provide rest and a change for the students.

For grades 10 and 11 one organizational pattern (18 hours per week, 6 hours a day) consists of 3 days at school (Monday, Tuesday, and Wednesday), and 3 days at the plant (Thursday, Friday, and Saturday), or vice versa. Another plan provides for every other day at the plant. Two groups of students, for example 10A and 10B, are rotated. While group 10A is at the plant, group 10B is in school and vice versa. One particular school had to "borrow" another 10th-grade class so that this system could work and still maintain uninterrupted production at the plant.

We learned about another organizational plan from a Soviet teacher. He said that grades 9, 10, and 11 will have 12 hours each, and students will spend 2 days in production training and 4 days of school work each week. This plan, we were led to believe, would be the one adopted for the 1959–60 school year.

According to the newly published curriculums for the 11-year school, this is to be the pattern.

One of the chief factors influencing the program of work experience in grades 9, 10, and 11 is the Soviet labor law regulating the number of hours a youth can work. For example, if a student is over 18 years of age he can work 8 hours per day in a factory or on a farm. If he is between 18 and 16, only 6 hours are allowed; and, if he is under 16, only 4 hours. A student normally is between 16 and 17 years of age at the ninth-grade level in Soviet schools.

Organizational plan for students at plant.—When a student is assigned to a plant for his work experience, he is given a physical examination. Then, the student receives his job assignment. These job assignments are determined by the plant, usually by the foremen.

Each student is assigned an experienced worker to help guide him in the practical work. In each shop department in the plant there are digest reports of information the student must know and of work he must do at the various proficiency grade levels. These act as a guide for him as he progresses on the job. Engineers at the plant, or the teacher at the school, instruct in the theoretical information during this period of work experience.

Another plan for grade 10 was one that gave the theoretical information (3 days a week) in the school until December 15. A final test was given to the students on this information. After that, they spent 3 days a week at the plant for 3 months, as apprentices, and took the qualification test for their proficiency degree in April. Under this plan most students received a proficiency degree rating of 3, and some, of 4.

Enterprises and the school.—Industrial and agricultural enterprises will be coordinated with the schools under the new curriculum reforms. These will be similar to the 10-year school except that the production training of the student will be increased considerably—to the point where students can become qualified workers. We also learned that girls will be able to get their production training in restaurants and accounting houses. Different schools will offer different specialties, depending on the enterprises within the area. Of course, rural schools will use collective farms for their production training.

Organization and Methods of Teaching Polytechnic Subjects

The normal teaching load in the Soviet Union is 18 periods a

week, and the teacher has one free period a day, we were informed. However, a teacher can teach more than 18 periods a week, in which case he receives additional pay. A polytechnic instructor in one rural school was earning an average of 1,000 rubles per month. His wife was also teaching in the same school. They lived in a "dacha" (bungalow) near the school and did not pay rent for the use of the dacha.

TEACHERS

Not only are polytechnic teachers trained formally in the 5-year pedagogical institute and university system, but they also come from the ranks of industry. We talked to many former engineers and skilled workers who teach some of the polytechnic courses. One of the reasons these engineers and workers teach these courses, especially in machine tractor training, we were told, is that the pedagogical institutes have until now trained few people skilled in this area of work.

During our discussions with teachers we asked them to tell us their background. The following are representative of the teachers with whom we talked.

Teacher No. 1.—Graduated from an agricultural academy and worked 19 years in a machine-tractor station; taught for 9 years; and now is attending pedagogical classes and seminars at an institute.

Teacher No. 2.—Graduated from Moscow University in the mechanics and mathematics faculty by correspondence; taught for 10 years and received his university education while teaching; has not had formal pedagogical training, but consultants from a pedagogical research institute have worked with him in developing methods; teaches 28 hours a week.

Teacher No. 3.—Graduated from a pedagogical school and is taking inservice training; has not worked in industry.

Teacher No. 4.—Graduated from a technicum in carpentry and has been in the trade 8 years; taught school since January 1959 and takes inservice courses in pedagogy; plans to attend summer school.

Teacher No. 5.—Graduated from a forestry institute of higher education and spent 9 years in factory work; taught for 5 years and takes inservice education course.

Teacher No. 6.—Graduated from a 10-year school and a 5-year technical institute; was a director of a factory and worked as an engineer; took courses in a pedagogical institute in pedagogy, psychology, polytechnics, and in upbringing of children.

Teacher No. 7.—Graduated from a 10-year school; worked 15

years in a factory and machine-tractor station; attended inservice training institute and took 3 courses: (1) methods of teaching, (2) how to work with students, and (3) general problems of education. This is his first year teaching.

Teacher No. 8.—Graduated from a 10-year school; received a university-level diploma in economics from the Plekhanov Institute of Public Economy; worked for 8 years in a textile factory with a master's rating; took professional courses in pedagogy to qualify for teaching position at a boarding school to teach sewing.

ASSISTANT TEACHERS

As in the case of chemistry and physics teachers, assistants help regular polytechnic teachers in many routine tasks in their classes. One of their main duties is to help students in the use of tools. Some of these assistants are qualified workers with proficiency degrees of 6, 7, and 8. In one school some of the assistants had graduated from a 7-year elementary school and a vocational school and had worked in industry 4, 10, or 20 years. One of the real problems mentioned to us was that these assistants, although qualified workers, did not know about the upbringing of children and had had no special education in pedagogy. Typical of these assistants are:

Assistant No. 1.—Graduated from a 10-year school; attended a technicum (carpenter training) for one year; taught one year and is taking inservice training in pedagogy.

Assistant No. 2.—Graduated from a 10-year general school and was a carpenter for 18 years; took a 3 months course in pedagogy pertaining to polytechnic education and special courses for assistants in an inservice training institute.

METHODS OF INSTRUCTION

Polytechnic instructors use a variety of methods to get across theory and practice to the student. Group instruction as well as individual instruction is used. The individual project method and group participation on a production job are some of their basic methods of teaching these courses.

Techniques used in teaching.—In discussing teaching techniques used in the Soviet Union, a teacher of fundamentals of machines listed the following methods: (1) Keep classes small, around 15 students, (2) divide class into small brigades (groups) while doing practical work on machines, (3) have students take notes, (4) explain aim of course (or lesson) clearly, (5) tell (lecture) students, (6) observe students' work carefully, (7) explain theory

first, (8) give students time to think, (9) use textbooks, if available, (10) use visual aids, and (11) demonstrate processes. The method of teaching we observed most in the polytechnic courses was that of individual instruction. The teacher, or his assistant, would give explanations to the student, demonstrate the process involved, and then observe the student in his work. The teacher would, if necessary, repeat the instruction until the individual or group understood. This technique was used most effectively.

In one workshop the teacher had all the necessary materials laid out for each student on a bench. In this group method of teaching, all students follow the instruction given to them by the teacher. Usually the teacher places the drawing of the part to be made on the board, and the teacher and students discuss the procedure for building it.

The students work according to the prescribed study plan on assigned work. They can do nonrequired work on projects if they so desire, after they have completed the requirements of the course. Generally, both theory and practical work are taught by the same teacher. The theoretical work relating to a polytechnic course is taught in the workshop or in a separate classroom nearby. Sometimes this separate classroom is referred to as a technology room.

In some schools, students are required to copy the drawing made by the teacher from the blackboard. They refer to this drawing while working in the workshops. We saw girl students working on a lathe following specifications from their penciled sketches. All students were making the same article, a machine bolt on a metal lathe. These particular girls had gotten behind in their work and had come to class after school to catch up. Table 7 illustrates the instructional procedure followed in making a bolt similar to the one the students in the school were making. As they progressed, the teacher checked their work carefully. Both the girls and teacher wore smocks or shop coats to protect their clothing. This was a common practice.

In another class students also wore safety glasses. These students were turning wood on a woodturning lathe. Each student in the workshops has his own set of tools, and he is required to keep them in good order. (See fig. 3-20.) All students are taught to sharpen their own tools and to follow safety precautions when using them.

The students in the various classes were using tools and machines in ways not unlike students use them in this country.

Some handled them expertly; others had difficulty and held them awkwardly. The quality of work varied a great deal. We saw some excellent machine work and some poor woodwork. By and large the useful articles made by the students served their purpose well. In some cases we felt the work looked hurried and the finish could have been improved.

One of the most effective methods of instruction, according to

Table 7. — Making manufactured object by means of machines[1]

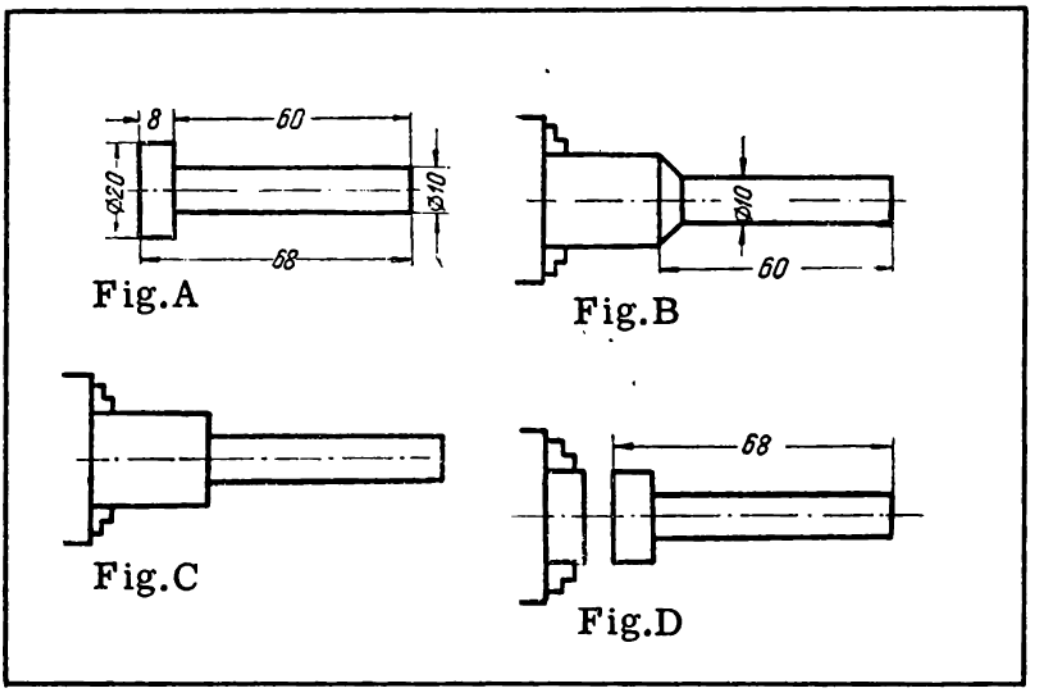
Name of Object.—Preparation for a bolt to fit a 17 mm. wrench
Material.—Steel st. 3 (See fig. A.)
Size.—Rod diameter 20 mm., 100 mm. long.
Equipment.—Turner's lathe, self-aligning three-jawed chuck

Procedure for work	Tools		Remarks
	Lathe tools	Measuring instruments	
1	2	3	4
1. To fasten rod in three-jawed chuck. To place the cutter. To determine low speed of spindle (60–100 revolutions per minute).	Facing cutting tool.	Scale rule	To be sure rod does not vibrate, check before fastening. Rod must protrude about 80 mm. Check the cutter according to alignment.
2. To face	Facing cutting tool.		
3. To change the cutter; to machine the rod — 60 mm. diameter 10 mm. during several passes. (See fig. B)	Squaring cutting tool (general purpose).	Scale rule, sliding caliper.	To be sure that machine does not cut too much, use hand feed and take off a small shaving.
4. To change the cutter; trim step in order to have straight angle. (See fig. C)	Facing cutting tool.	Sliding caliper	
5. To cut exact size for bolt. (See fig. D)	Cutting off tool.	Sliding caliper.	Make your cutting in such a way that width of channel (slot) is wider than width of cutter.

[1] M. A. Zhidelev. *Mashinovedenie v 8–10 klassakh gorodskoi shkoly. (Machine Study in 8th-10th Grades of City Schools.)* Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1958. P. 162–163.

Remarks

1. Preparation of bolt should be followed by filing sides and cutting the thread. If you have a hexagonal rod of the same size, use it; it is convenient to fasten in the three-jawed chuck.
2. If there are several preparations, one can use material 150 mm. long, and the rod will be machined from both sides (with inversion) 10 mm. When you cut material, you will get 2 bolts; and this procedure will be economical.



our informants, is the excursions students take to industry. These excursions help them to get a better idea of industrial life. According to the curriculum, school authorities plan 6 days a year for excursions, beginning with the fourth grade.

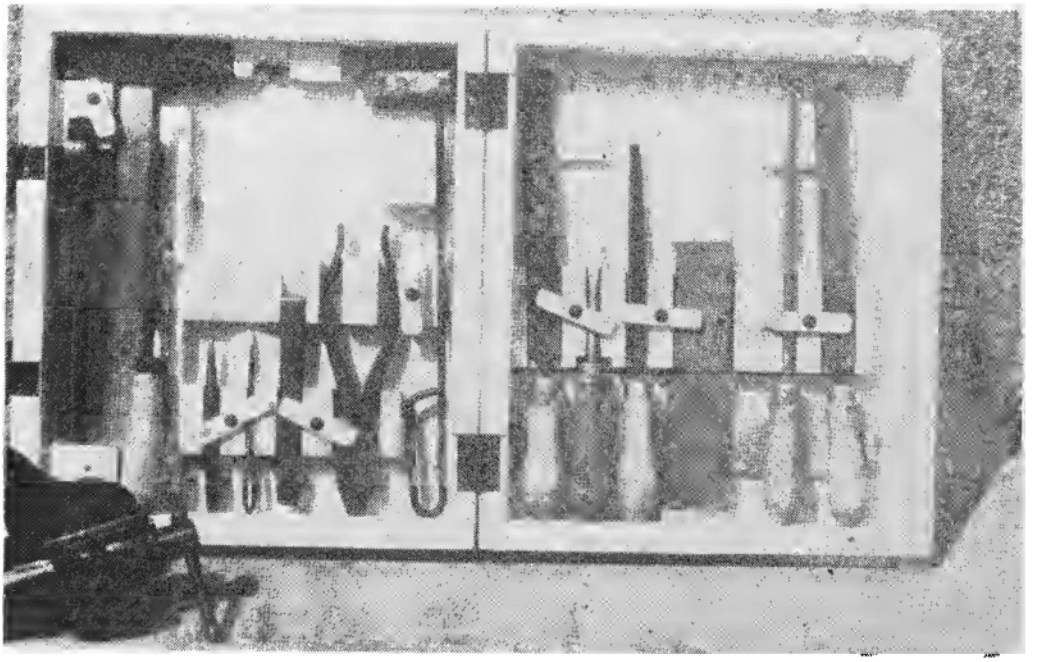


Figure 3-20.—An individual tool set used by students in metalwork.

The head polytechnic teacher in one school explained the methods they used in their school. Each instructor has a prescribed program and teaches both theory and practice in the workshops. He teaches the use of instruments (tools); then students practice using them. Normally, students do their project drawings in the workshops, but in this particular school they do not make their own drawings in the shop. The polytechnic teacher explained that his pupils receive their material from a factory and that they make the drawings in the technical drawing classes at school for the work done in the workshops. In the workshops, he said, they work from a model. At the end of the class period the students clean up their individual work stations, and some students are assigned to sweep the floors.

In School No. 6, Kiev, the teacher of polytechnic courses showed us a small model of a hacksaw which his students had made. In his classes students make their own drawings and then make the article. For example, each student made a drawing and then one or two parts of the model hacksaw as a part of his work in grade 8. The teacher first acquaints the student with his working area, tools, and safety rules. Then, he instructs students in the use of the simplest tools, emphasizing their safety precautions. Finally, he demonstrates processes and shows each student how to use the tools and machines personally.

It is generally believed by Soviet educators that the student should know handwork before he uses machines. During the first three grades and handwork is closely connected with academic lessons.

Another method, not mentioned before, is the use of persons from industry to talk to the classes. At rural School No. 14, Zagorsk, for example, workers came from the factory to talk to the pioneer clubs. This practice aroused the students' interest. Films, slides, charts, and collections are also widely used. In fact, many schools had extensive collection of charts on all types of subjects. In the workshops, charts were hung on the wall or stacked in one corner of the room.

Table 8 shows an example of study plans for workshops in schools for polytechnic instruction, grades 5, 6, and 7. It lists the sequence in which the content is taught, and gives suggestions as to methods, visual aids, tools, materials, and objects to be made.

Examples of methods of instruction in production training.— In Kiev, at 10-year School No. 43, eighth graders were working on a production job making full-sized doors. Industrial workers from the neighborhood factory were working on production

Table 8. — Example of study plans for workshops in schools[1]

Plan for Grade 5

Sequence number	Content of subject	Object to be made	Material	Tools	Visual aid	Remarks
1	2	3	4	5	6	7
	INTRODUCTION					
1	The task of practical studies. How to make the article. Manufacturing of parts according to given size and machining. Demonstration. Showing shop's equipment. Working place and organization. Internal arrangement. Main rules of safety engineering in shop.	----------	----------	Supply of tools for machine and joiner.	Show examples made by students, such as box, shelf, hammer, 2 or 3 models.	First lesson, all students are included; second lesson, according to groups in mechanical shops or woodshops. Second lesson group selects student leader.
	WOODWORK					
2	Sawing longitudinally and across grain. Bench for carpenters; way to grip working material. Handsaw and hacksaw and its working principle. Type of saw teeth. Procedures for preparation of saw. Way of sawing wood — longitudinally and cross grain.	Box. Cutting boards for making a box.	Preparation for sawing grain longitudinally and two cuts across the grain; boards 550 by 140 by 25 mm. (pine and fir).	Pencil, ruler, handsaw or hacksaw.	Sample of a box to be made in the future. Plywood or cardboard models for various types of saw teeth (three types for cutting wood: longitudinally, across, and in combination).	----------
3	Planing. Planing both sides, marking out according to drawing and control of surface. Structural texture of wood. Jack plane and plane (smooth). How to use Jack plane and plane (smooth). Elementary teaching of sketches and technical drawings for describing parts in details. Ways to check the surface.	Box. Cutting boards for making two walls for the box.	Board 550 by 140 by 25 mm. (pine and fir).	Handsaw or hacksaw. Jack plane, plane (smooth), pencil, angular ruler, mallet.	Piece of wood with various shearings for using during the demonstration of structural texture of wood.	----------

[1] A. G. Dubov, *Prakticheskie zaniatiia v uchebnykh masterskikh; Metodicheskoe posobie dlia prepodovatelei truda V-VII klassov.* (Practical Studies in the School Workshop; Methodical aid for teachers of workshops, from grades 5–7.) Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1957, p. 182–198.

4	Finishing planing in limits of given dimension and marking by means of ruler, square, and surface gage. Cutting boards into two parts (two walls for box). Miter box, application and its purpose. Ways to measure angle between the surfaces. Surface gage. Facing on controlling surfaces. Procedures of setting jack plane and plane (smooth).	Box, two sides	Board 550 by 140 by 25 mm. (pine or fir).	Same as above and marking tool (surface gage).		
5	Making two remaining sides for the box (sawing, planing, marking, and checking). Main type of woods and their particular characteristics and features. Drawing a sketch of object pertaining to work explaining several parts in details.	Box	Board 550 by 120 by 25 mm.	Same	Drawing a box. Chart of various types of wood.	
6	Sawing bottom out of plywood. Assemblying box. Nailing parts together. Sand papering and using mordant (stain) and lac. Brief information on using this material. Ways of countersinking with aid of bit or using drilling machine.	Same	Plywood, thickness 4–6 mm. Size 320 by 210 mm.; sand paper ½ page; mordant; lac; nails 20–25 mm.; or screws.	Same as above. Use hammer, pincer, tampon, brushes (depending on type of covering). For screws use awl and screwdriver.	Chart — "Nails and Screws." Chart — "Purpose of Countersinking with Use of Screws."	
7	Students who were not able to finish their assignments on the previous lesson will continue working on the box. Students who already finished their assignments could work on handle for hammer which could be accomplished during one or two lessons. One could repeat the information pertaining to drawings which consist of several parts drawn in detail. Reading of drawings. To apply the information which is given on the blueprint as to materials to be used. Allowance for finishing.	Box, handle for hammer, name plate, cutting board, etc.	Plywood, board	Same	Chart with drawings pertaining to subject of study, showing parts for experience in reading and checking the knowledge of students.	Accepting and evaluating the work.

Sequence number	Content of subject	Object to be made	Material	Tools	Visual aid	Remarks
1	2	3	4	5	6	7
8	Analyzing and explaining drawings of shelf for washbasin. Marking material, sawing sidewalls, back of shelf, and cover of shelf. Repeating way of using hacksaw and saw, and marking.	To make shelf for washbasin.	Board dimension 700 by 160 by 20 mm., plywood 350 by 140 mm.	Ruler, square, pencil, hacksaw or saw.	Table of drawings for shelf with indication pertaining to order of making the shelf.	
9	Planning parts for shelf. The design of the bit and way of drilling holes. Drilling machine, its design and the way to drill. Rules for safety engineering during drilling. Finishing ends of sidewalls for shelf.	Same as above	Same as above	Same as above, jack plane, plane (smooth), bit, device for using a bit for drilling (if there is no drilling machine).		
10	Ways of making round rod for shelf to be used for washbasin. Methods of cutting a hole and trimming with a chisel. Cutting wood block for rod. Making rod with round joint tongues at the end. Assembly of shelf for washbasin. Trimming, sanding, and using lac, etc.	Shelf for washbasin.	Piece of board, thickness 25 mm. for cutting block 25 by 25 mm. 300 mm. long.	Same as above. Chisel 12–14 mm., brushes.	Chart showing how to make round rods with aid of plane (according to various stages of work).	
11	Try to finish shelf. Students who complete their assignment during three lessons will do the other work which is designed to be accomplished in one or two lessons.	Same as above	Same as above	Same as above	Same as above	

12	Drawing a straight line on sheet metal. Marking, using squares. Cutting sheet metal according to marked lines. Connecting two sheets with simple seam. Organizing working place; vises and their use. Main type of sheet metals. Illustrate on drawings the parts which are to be made from sheet metals. Ways of marking sheet metal with aid of square, ruler, and marking tool. Ways of cutting sheet metal with snippers (for metal). Joining together by means of simple seam; its purpose and application.	Two plates which are united by means of simple seam.	Black sheet metal thickness .4–.5 mm. The size 200 by 100 mm.	Ruler, square, marking tool, center punch, hammer, mallet, snippers and mandrel stake.	Chart — "Using a Simple Joining Seam," showing the stages of work drawings, and general picture of juncture. To show various types of samples of the sheet metal.	----------
13	Marking, cutting, unfolding, and bending of walls for dustpan. A drawing made for using on sheet metal. Transfering data from blueprints to material. Sequence of how to bend the sheet metal.	The dustpan	Roofing or galvanized sheet metal thickness from .3 to .6 mm. the size 230–250 sq. mm.	Ruler, square, marking tool, hammer, mallet, snippers, center punch, and mandrel stake.	Type of dustpan. Dustpan made of cardboard for demonstration of ways of bending the walls.	The first stage of marking and bending should be conducted on paper.
14	Continued marking, unfolding, cutting, and bending of dustpan walls. Trimming dustpan with aid of file and emery paper.	----------	Same as above	Same as above	Same as above	----------
15	Making a handle by cutting, bending the metal, filing ends, and drilling holes. Joining handle with dustpan with aid of rivets. Explaining the drilling machine and its design. Ways of drilling the holes and using rivets. Ways of cutting the strips by handsaw or using chisels. Files and the way to use them.	Same as above	Strip 25 by 30 by 2–2.5 mm.	Handsaw or chisel, rivet set, and flat files — bastard file and smooth-cut file.	Chart showing various types of rivets.	----------
16	End of the work. Removing projected edges. Painting of dustpan. Making 4 laps to reinforce the handle. Brief information about oil painting, metal treating, and use of enamel painting. Ways of bending laps and use of vises.	Dustpan and accessories for the box.	Oil painting, enamel, and lac.	Same and brushes. The sheet metal size is 50 by 80 mm.	----------	Receiving and evaluating the work.

Sequence number	Content of subject	Object to be made	Material	Tools	Visual aid	Remarks
1	2	3	4	5	6	7
17	Try to finish work in making of laps, painting them with oil lac. Make two handles out of wire — 4 mm. Transfer the drawing on material. Ways of bending and filing ends of handle.	Accessories for the box.	Steel wire 3–4 mm. The length is 300 mm.	Ruler, square, marking tool, hammer, shears, punch, smooth-cut file, and brushes.	Show sample of box with accessories. Chart drawings and accessories for the box.	----------
18	Try to finish making accessories for the box and place it together. Ways of placing metal accessories upon finished wooden parts.	Same	Nails and screws — 8 pieces.	Ruler, square, marking tool, hammer, awl, and screw-driver.	----------	Receiving and evaluating the work.
19	Making window corners from sheet steel — thickness 1.5–2 mm. — with marking, cutting with chisel in vise, straightening, filing, drilling, countersinking, and trimming corners.	Window corners.	Plate made of sheet metal steel 18 by 18 mm., thickness 1.5–2 mm.	Ruler, square, marking tool, punch, hammer, chisel, flat file bastard, barrette file, and smooth-cut file.	The drawings of window corners with indication of sequence for making. Show the sample window corner.	During the 19–21 lessons some students finish their [unfinished] work early.
20–21	Ways of marking corners and holes, punching the lines which were marked; ways of cutting with chisel in vise following the level of jaws, filing the corners, drilling and countersinking holes for screws, filing corners with file and emery paper.	Same	Same	Same	Same	If the students complete their assignments (completing one or two corners ahead of time) then it is desirable to have them make loops or hinges with marking according to templet. Receiving and evaluating work.

22	Divide class into groups and give assignments. Study drawings and preparation of materials. The group should be acquainted with contents of work. Brief description of articles and parts (in the field of their use).	Feeding rack for chickens. Making birdhouses. Stand for soldering iron. Awl and screwdriver. Wind vane. Steam turbine. Hanger with metallic hooks.	Material needed for making parts and for other purposes.	Necessary carpenter's and mechanic's tools.	----------	The work should be completed by groups of two or three students. During the 12 lessons (24 hours) the groups, depending upon the number of students, could make one or several objects.
23	Using the sketch and technical drawings, show how the parts are put together. The sequence of how to make and assemble the parts. Making the parts. Assembling parts and finishing the models. Conclusions.	----------	----------	----------	----------	Receiving and evaluating work.
24	To evaluate students' work for the whole year. Selecting the best work for school exposition.	----------	----------	----------	----------	----------

NOTES.—1. If there are two shops, one for woodwork and the other for metalwork, the second group will begin their work with metal (see lesson Nos. 12–21). During the first lesson, the student group is getting acquainted with the working place, how to work with metal, with vises, and with other basic mechanical and assembly tools.

2. The theme for combining work and technical models is identical for both groups of students.

3. To get acquainted show students how to sharpen the tools. The practical work on how to sharpen the tools must be done by 2 to 4 men during each lesson.

4. Excursion to be carried out in enterprises for acquainting students with machining of materials and organization of production. These excursions are done at special allocated times for the excursions.

Plan for Grade 6

Number of lessons	Content of subject	Object to be made	Remarks
	INTRODUCTORY STUDY		
1	Sawing, planing, filing, drilling are explained as various processes of cutting. Different shapes of cutters. Machine and hand-machining of metals. Productivity and quality of work which is done by means of machine and hand tools. Contents of work for whole academic year.		Place students according to working places. First lesson is given to the whole class. In second lesson students are divided according to shops by groups. At end of second lesson students elect their own leader.
	WOODWORKING		
2	Sawing the wood. Sorting wood material. Explaining blueprints and the sequence for making a box with a cover. Prepare boards for walls and cover. Rules of safety engineering during work with wood using hand tools.	Box with cover	During the marking, pay attention to allowance. Cover and bottom could be made out of plywood.
3	Raw and dry wood. Repeat information petraining to types of wood. Sawing and planing of wood for making wall and cover for the box.	Same	
4	Defects in wood. Chisels. Chiseling depression. Marking tongue joints and ears on the walls of the box. Filing tongue joints and chiseling ears.	Box with cover	Show slides or films pertaining to work in sawmill.
5	Assembling of box and sanding tongue joints. Using wood glue and the way to join by means of tongue joint.	Same	
6	Sanding box after gluing. Cutting covers and placing hinges. Finishing box with mordant and applying lac.		
7	Finishing the wood box. Installing a handle in place, and hooks.		Receiving and evaluating work.

8	Explaining blueprints and the sequence of how to make shelf for books. Prepare material for walls and shelves.	Shelf for books	During the marking, pay attention to allowance for working with material.
9	Planing parts. Marking the junction. Cutting tongue joints and ears.	Shelf for books	
10	Chiseling ears. Trimming tongue joints and ears and preparation for putting together. Assembling of shelves using glue.		
11	Sanding shelf after gluing. Treating shelves with mordant and lac. Placing ears for hanging.		Students who complete their work ahead of time will make a handle for hammer or other object which could be finished during one or two lessons. Receiving and evaluating work.
	WORKING WITH METAL		
12	Ferrous and nonferrous metals. Cast iron and steel, their particular quality. Different types of steel. Rules and safety engineering, during the working with metal. Study of the blueprints of accessory for the box (handle, hooks, and straps). Making two straps.	Accessories for the box (handle, hooks, and strap).	
13	Making handle and hooks	Same	
14	Try to finish making straps, handles, and hooks for hanging.		
15	Making hanging hooks for shelves	Hooks for hanging shelf	
16	Completion of making hanging hooks	Same	
17	Files, their type and purpose. Ways of filing flat and curved surface. Checking. Sliding calipers. Ways of using sliding calipers. Studying prints and sequence of making hammer. Marking of hammer. Filing hammer.	Hammer 200–300 grams	

Number of lessons	Content of subject	Object to be made	Remarks
18	Drilling hole. Making hammer	Same	
19–20	Ways of filing hole		
21	Purpose of thread. Internal and external thread and their principal elements. Various types of cutting thread instruments and devices. Cutting bolt and nut M–6 or M–10.	Bolt and nut	
	Combining Work and Technical Modeling		
22–33	Studying blueprints of patterns and models of apparatus. Preparing material for making the parts. Assembling of parts. Finishing.	Box with glass wall for observation of roots growing. Inclined prism. Maxwell pendulum. Hand roller. Apparatus for comparison of heat conductivity. Hacksaw. Coping saw.	Models, apparatus and instruments are made by groups of students. Each group consists of three students. Each group prepares one or two objects.
34	Conclusion. Evaluation of students' work for whole academic year. Selection of students' work to be used for school exposition.		

Notes.—1. Group No. 2 began its study about mastering ways of work in metal. (See from 12 to 21.)

2. Theme of work and technical modeling are identical for both groups.

Plan for Grade 7

Number of lessons	Content of subject	Object to be made	Remarks
1	Contents of work during the academic year. Understanding about technical process and technological chart. Analyzing drawings of instruments, models which are to be made during the study work.	----------	First lesson is given to whole class. Second lesson is given to separate groups. At end of second lesson, students elect their leader.
2	Design of wood turning lathe. Ways of operating lathe. Preparation of block. Fastening the block to the lathe for machining. Ways of using flat and semicircle chisel.	Handles for tools. Legs for apparatus. Cams for abacus. Cylindrical shafts made for shelves and other objects.	Turner's work conducted according to diagram. For each lesson on turning lathe, two students are working (each one 45 minutes).
3–15	Dividing groups by two or three students. Studying drawings. Planning to make objects. Preparation of material and making the parts. Trimming.	Handsaw for metal. Garden saw. Demonstration dynamometer. Installation of mortice lock. Apparatus for demonstrating waves. Cage for birds. Medical kit with lock. Level for carpenter. Grass cutter. Tubular dynamometer.	----------
16	Principal rules of wiring cords and wires. Conventional sign for electrotechnical charts. Rules of safety engineering during work with electrical current.	----------	----------
17	Splicing and branching wires. Soldering wires. Terminating wires for connecting with fixtures.	----------	----------
18	Taking apart and assembling fixtures (lamp socket, fork, switch, on-off switch, fuse). Connecting lamp socket and plug.	----------	----------
19–21	Making switchboard and planning the wiring and assembling. Switchboard should include cut-in safeguard, lamp socket, switch, and plug.	----------	----------
22	Construction and the purpose of everyday use electric apparatus, such as iron, plate, teapot. The way to repair them.	----------	----------

Number of lessons	Content of subject	Object to be made	Remarks
	TECHNICAL MODELING WITH APPLICATION OF ELECTRIC ASSEMBLY WORK		
23	Coiling and assembling wiring. Clamp. Design of coils. Ways of making frames and winding coils.	Coils for electromagnet and other models and apparatus.	
24	Making of framework and winding coils		
25–33	Analyzing drawings for apparatus and model. Making parts. Assembling parts. Testing apparatus and model. Finishing.	Electromagnet. Electromagnetic amperemeter and voltmeter. Electric pendulum. Electric bell. Models of electric motor. Models of telegraph apparatus. Rheostat for demonstration.	
34	Conclusion of study. Evaluation of work of students for whole year. Selection of work for school exposition.		

along with the teacher and pupils. After a short time the worker and student exchanged work stations. The workmen would show the student what to do and then let him try it for himself. On the wood planer, for example, a student fed long boards into the machine and a worker removed them as they came out and stacked them in a pile. Individual and small group instruction were the predominant methods of instruction. Theoretical instruction is taught in a separate classroom by the teacher who is a university graduate, and wood technology in this school is taught by a graduate of a wood technology institute.

Other processes going on simultaneously in the woodworking shop were sawing with the circular saw, joining, boring, making lap joints, planing by hand, and gluing. Various operations besides these were being conducted in other shops; and nearly always students worked along with a qualified worker from the factory. Other production work done by this school involved the making of cashier boxes, bookcases, and some individual jobs. The production job was coordinated with class study by the teacher and with work in the industrial plant by plant officials. This school is one of the largest general education schools for production training in the city of Kiev. It had 1,150 students enrolled at the time of our visit.

Fig. 3-21 shows a small grease cup and its cap, which were made at another school. This grease cup is another example of the production jobs involving machine work.

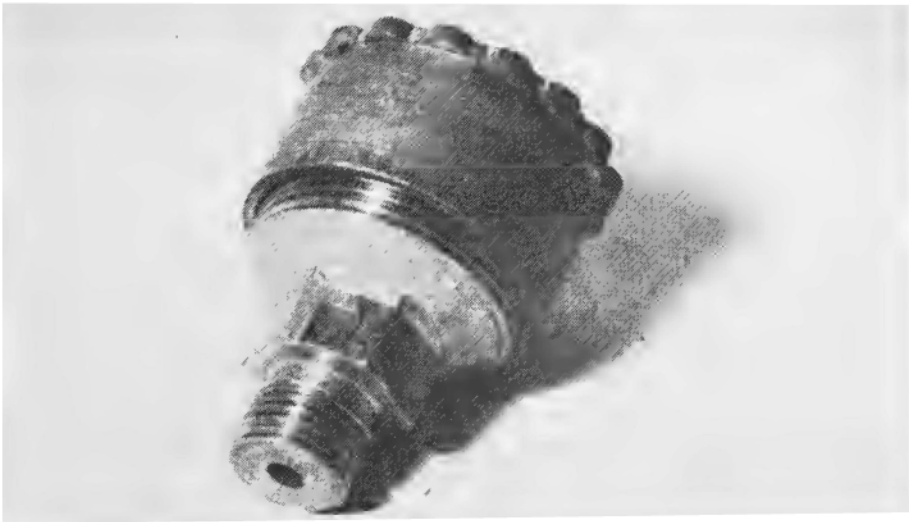


Figure 3-21.—Grease cup made by students in school workshops.

HOMEWORK

Although no homework is regularly assigned in polytechnic courses, one of the interesting comments we heard during our visit dealt with homework. We heard from teachers, directors, and research people that improvement of classroom instruction was the best way to help students learn, and that the homework assignments were being reduced. In fact, one educator stated they are "doing away with homework." This was a generalized statement pertaining to the whole school and not any particular course or group of courses. We were made to feel during our visit that Soviet educators are concerned at the amount of homework the students are required to do and are taking steps to reduce the load. One of the basic steps is to improve the effectiveness of the teacher in the classroom.

Books.—Generally speaking, homework assignments are not given to pupils who take polytechnic courses in grades 5 to 7. In fact, at present they do not yet have a textbook for these pupils. However, one is being prepared for this level. The teacher has a guide (textbook) which he uses in the preparation of his lessons and in determining details of content (theoretical and practical) for these courses.

Starting with the eighth grade, textbooks are used in the various polytechnic courses, and students purchase them at a nominal fee. In one school we were told that in grades 8 and 9, the students are not given homework assignments in their fundamentals of machines course. They are supposed to get all the information in school. This procedure seemed strange because the texts were quite comprehensive and it would appear to be difficult for pupils to assimilate this knowledge without homework in these courses.

Although the schools have libraries, the polytechnic reference books are often kept in the workshops for the students to use there.

CORRELATING SUBJECTS

One of the major problems Soviet educators face in attempting to relate school to life is that of introducing a better correlation between all subjects, especially with the polytechnic courses. Table 9 shows a plan for relating physics problems to production work. This particular plan of polytechnic instruction was devised by a physics teacher in order to relate more educationally the theoretical problems in physics to the practical problems illustrative of theory applied in industry. Methods by which this relationship is taught are stated in the columns on the right.

This general plan was incorporated into the reference book used by teachers in experimental schools during 1958–59.

EVALUATION

As in other classes, students in polytechnic courses are evaluated and graded using a numbering system from 5 to 1. A mark of 5 is considered excellent; 4, good; 3, passing; 2, unsatisfactory; and 1, failure. When a student does an assignment, or completes a specific job, he is given a mark. The teacher keeps these marks in a notebook and averages them at the end of the course for his final grade. In the workshop courses in grades 5 to 7, one teacher

Table 9. — Plan for relating program topics in physics to problems of production[1]

Physics topics	Problems in production training	What is the relationship?	
		Preliminary explanation of scientific principles during lesson period	Application of principles in production by pupils in physics
1	2	3	4
Electric capacity	Preparing, assembling, and working with capacitors.	Measurement of electrical capacity; units of measurement, design of capacitors.	Excursion; write report on subject — — "How capacitors are made and their application."
Resistance of conductors	Applying and using various types of resistors which are manufactured by a plant.	Physical nature of resistance; units of measurement; solution of problems.	Give general conclusion on the use of resistors; question pupils.
Current in liquids	Insulating parts with protective covering.	Explanation, solution and calculation of problems.	Excursion to electroplating shop; make report about trip.
Heating effect of current	Using heating effect of current in devices and their parts.	Schematic drawings of main apparatus and devices which are used in plants (soldering iron, smelting furnace, etc.).	Explain devices and their construction during excursions to plants.
Magnetic field	Constructing gages (ammeter, voltmeter); insulating separate apparatus in units and junction points; designing and repairing D.C. and A.C. motors; designing and repairing transformers.	Explanation of principle of construction and opcration in apparatus and machines.	Excursion to control and testing laboratory, to transformer shop, and to motor repair shop.

[1] Shapovalenko, S. G., *ed. Soedinenie obucheniia s proizvoditel'nym trudom uchashchikhsia. Opyt piatidesiati shkol R.S.F.S.R.* (Combining instruction with production work of pupils. An experience of fifty schools in the R.S.F.S.R.) Moscow, Academy of Pedagogical Sciences of R.S.F.S.R., 1958. P. 69.

said he grades on each operation, and the summation of these grades is the mark for a particular object made by the student. Generally, written tests are not given in these grades in polytechnic work; however, practical tests are. The practical work is compared to the drawing specifications and a grade is given for this test.

Written tests, or control work, as they are called, begin in the eighth grade. During the production training at the plant, they also have a qualifying test which, if they pass, determines their proficiency rating. Written tests, however, are used to evaluate the student's knowledge in the theoretical work. One of these tests on the tractor follows.

Examination on the Tractor[1]

Pupil of 10th Grade, School No. ....
Family name..... Name.....
School address.....
.....
Date..... Month..... Year..... of the completion of work.....
.....

1. Name and point out the purpose of the principal machinery parts and the engine system:

Name of machinery parts and engine system	Purpose
1.	
2.	
3.	
4.	
5.	
6.	
7.	

2. Indicate in the table the direction of movement of the piston and the position of the valves in the cylinder of the tractor engine.

Timing	Direction of movement of piston in cylinder	Valve positions	
		In-take	Exhaust
In-take.....			
Compression.....			
Working stroke.....			
Exhaust.....			

3. Enumerate the possible causes of overheating in the engine's carburetor.

4. How does the tractor's pulling power change through shifting in the gear box from a lower gear to a higher one?

[1] Form of examination used at 11-year School in Gorki-Leninskie, Moscow Oblast.

Research

We had many discussions with educational researchers in the Soviet Union. There are 17 specialized institutes of pedagogical research in the U.S.S.R., and it is intended in the future to develop this system further, including creation of a separate institute for polytechnic education. We learned that this plan would be in line with the new 11-year school program, which in the last three grades (9, 10, and 11) will devote two-thirds time to general education and one-third to polytechnical and production training. Of the polytechnical and production training program itself, one-third is to be theoretical and two-thirds production training.

RESEARCH PROBLEMS

At the Scientific Research Institute of Methods of Teaching in Moscow, syllabuses are developed in all subjects as well as the methods for teaching these subjects. In the polytechnic section of the institute, there are 3 groups dealing with problems of polytechnic education. Group 1 deals with polytechnic education in the 8-year school; group 2, polytechnic education in the city schools (grades 9, 10, and 11); and group 3, polytechnic education in the rural schools (grades 9, 10, and 11). Films for polytechnic education are developed; at present, one is being completed on the chemical industry. There are three experimental schools in Moscow where new methods of teaching and new curriculums are tried out.

Interrelationship of subjects—Each school subject in the Soviet view has an area of knowledge unique to itself, yet each subject is a part of the whole educational scheme. Therefore, Soviet educators eschew the idea of general science courses, or a combination of biology, physics, and chemistry. It is their belief that the child must have the fundamentals of each individual discipline separately. The problem they face, we were told, is to give a system of knowledge in each subject and an instructional approach that provides the interconnection. For example, in biology, first comes the teaching of botany. The students are taught to see botany in relation to raising fodder for animals. If the instructional approach is neglected there will be no connection between the two, they say. Soviet educational authorities said that unfortunately some teachers do not see this point of view and expect students to get only their individual subject.

In the field of polytechnic education, for example, such as in mechanics and machine technology, which applies the laws of

physics, there is an interconnection of principles. Soviet educators state that they cannot see definite boundaries in the industrial application of these principles. The basic connecting link between school and life is through polytechnic education and labor at the enterprise. This, we learned, was the "golden thread" which is the interconnecting link.

Specific research problems in polytechnic education—Some of the problems Soviet specialists are concerned with in their research involve the study of constructive and technical abilities in students. They admit that it is complicated, but that some of the components can be separated. The following are examples: First component—skill development; second component—spatial ability; third component—time factor (its effect on exhaustion, and shift of thinking due to rapidity of machines and automation); fourth component—technical thinking (the ability to solve technical problems and being prepared for technical progress). Soviet psychologists are directly interested in these components and are studying them.

Research procedures were described to us. Specialists sometimes go to the schools to study and observe teachers at work, get reactions from students and teachers, and record observations. Then they study a number of classes and make quantitative and qualitative analyses of their work. A psychologist, methodologist, hygienist, and others may all observe the same class and report different points of view. Following these procedures, they analyze the material separately and then meet as a group to discuss their data. Some of their published research in the Russian language deals with (1) the role of labor in the process of schooling and upbringing of children, and (2) self-controlled attitude toward labor—formation of this attitude.

Examples of Research—Two examples of reports on research in the Soviet Union (printed in English) which were given to us are *Researches in Psychology of Learning* and *Some Problems of Labour Psychology and Labour Training.*

An excerpt from the first report touches upon some problems of the psychology of learning being dealt with by the Research Institute of Psychology under the Academy of Pedagogical (Educational) Sciences in Moscow. It is as follows:

> Soviet educationalists and psychologists are facing the task of finding most effective ways to combine theoretical knowledge with practical activities, to teach pupils freely [to] apply their knowledge in solving the learning and life-practical problems and to overcome all formalistic traces in knowledge. That is why a great number of works in psychology are devoted to the analysis of the process of applying knowledge to the solu-

tion of various problems by pupils, to the analysis of those difficulties that pupils meet with and the ways of their overcoming.

Examining the use of knowledge in the solution of learning problems, we came, in a number of cases, across the following facts: a textual abstract problem, requiring to find the relation between abstract values, came out to be easier for some pupils (of 11–13 years of age—5–8 years of learning) than identical textual problem with concrete content (including concrete quantities) while this type of problems, in its turn, appeared to be easier than identical visual-practical problems that required for their solution actions with objects. This fact has been proved on different learning material: solving problems in physics (the works by Z. Y. Kalmykova and E. A. Fleshner), geometry (researches by V. Y. Zykova), constructive-technological problems (works by P. M. Yakobson and Kurdriavtsev).

How this fact can be explained? It may seem at the first glance, that this fact contradicts to the generally accepted thesis that in the evolution of the child's thinking the transition is happening from concrete to abstract, from the manipulation with objects to the actions 'in mind.'

This, however, is only a seeming contradiction. The concrete problems in two, above described, cases are of different character. Some of them do not require from pupils to go out over the limitations of the concrete, while others, belonging to those, that present certain difficulties for pupils, contain some general abstract principle. Pupils must 'perceive' this principle in a new concrete situation, drawing themselves off from its non-essential features.

After that it becomes clear why such concrete problem appears to be even more difficult for pupils than the corresponding abstract problem. In the first case the pupils must draw an independent abstraction on the basis of particular features of some concrete data whereas in the second case they deal with ready products of abstraction.

In the course of solving concrete problems, requiring the use of a general principle, of primary importance is one of the sides of the process of abstracting which is usually called 'negative abstraction' and which means throwing aside non-essential concrete properties of objects.

Naturally, the question may arise: what are the grounds to consider that the main difficulty lies in the negative abstraction and not in the positive one? Perhaps, pupils, going through certain difficulties in solving some concrete problem, assimilated the principle which is being realized in it not well enough?

The researches have been made under special circumstances that exclude the possibility of an insufficient comprehension or ignorance in regard to the corresponding notion or principle.

Before the chief experiments the research workers purposely 'equalized' the scope of learning material that should be used by pupils in 'experimental' problems. Moreover, in some cases, before starting the solution of the problems, the experimentalist [re] minded the pupils about a chance to use the principle they had studied.

Thus, for example, before 6 and 7 grade pupils were required to give the projection of an excavator, they received preliminary instructions under the title: 'Mind of jacks and their arms.' (*sic*) Besides, only those pupils were admitted to make experiments who successfully solved the

corresponding abstract problems, using schematic drawings (study by Yakobson).

Under such conditions some pupils successfully accomplished the projection of an excavator while others failed to 'perceive' in a new concrete problem the principle of a jack, known to them. Separate details of the concrete mechanism 'screened' an abstract scheme, in other words, they could not draw a negative abstraction.[8]

Excerpts from the second report dealing with some researches of the Laboratory of Labour Psychology, Research Institute of Psychology, under the Academy of Pedagogical (Educational) Sciences of the R.S.F.S.R., are the following:

. . . it was shown that one of the chief reasons for few cases of insufficient control and low quality of the products is the change in the structure of the working process that have been made by the worker without sufficient grounds due to an insufficient understanding of technological requirements, underestimating of losts, connected with correcting defects and insufficient control of the quality of products manufactured by the worker. The comparison of the psychological features of workers with various qualities of production showed that the workers, combining high productivity with better quality of production, possess a wide technological outlook and higher level of general culture and industrial skills and more serious attitude towards their work.[9]

And further:

Labour training in the Soviet Union is started at the lessons of manual labour in primary classes; it is continued in school workshops and is completed in senior classes with industrial practice at works and factories. In accordance with polytechnical education principles pupils are required to acquire that general knowledge, skills and abilities that would allow [them after school graduation] to easily master various kinds of vocational work in industries.

At the same time, the labour training has its aim the development of such personal qualities of pupils as love for work (as the source of high satisfaction), activity, resourcefulness, creative initiative, abilities of using in practice the knowledge and habits, acquired at school, ability to independently overcome difficulties in work, persistence, sense of responsibility for both individual and collective work. . . .

Favourable conditions for the development of technical thinking, creative activities, resourcefulness, inventiveness are being created with an active method of labour training when the teacher encourages pupils to act not only in strict accordance with the instructions, but independently, under the conditions of partial fulfillment or absolute absence of the instructions. In such cases the pupil has to choose actions and set up the labour process on the basis of his own analysis of the labour process and its conditions, examining the correctness of his actions and decisions in practice.

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[8] E. D. Mrs. N. A. Menchinskaya, Vice-Director of Research Institute of Psychology, Academy of Educational Sciences. *Researches in Psychology of Learning.* Moscow, 1958. P. 2–4.

[9] Dr. E. V. Gurijanov, Director of the Laboratory of Labour Psychology, Research Institute of Psychology, Academy of Educational Sciences. *Some Problems of Labour Psychology and Labour Training.* Moscow, 1958. P. 4.

To find the methods of activation of pupils' mental activities in the course of accomplishing labour assignments and forming their abilities to organize an easy labour process independently, we have arranged, in cooperation with school teachers, experimental teaching. During the teaching the pupils, after exercises that provide the possibility of successful accomplishing separate operations were suggested the tasks, requiring an independent construction of series of actions, first short ones, consisting of two-three actions, and then more complicated. A comparison of results of control-works, executed at the end of a learning year by the pupils of experimental end control classes, showed essential advantages of the experimental class pupils in regard to the abilities to organize the labour process independently. The general quantity of wrong actions of the experimental class pupils in the course of fulfilling control-works was two times less as against control class pupils (experimental class—70 wrong actions, control class—157 under more favourable general learning conditions). The experimental class pupils were more successful in the transition of previously adopted abilities in the course of accomplishing a new task that had not been taken before.

In order to define the role of separate elements of instructions in the process of forming labour abilities by the pupils of vocational schools, V. V. Chebysheva has made a study with the aim of establishing the role of word, image and action in teaching. The pupils were required to execute a series of new to them work assignments' on the basis of a mere explanation or a mere demonstration. The examination has shown that the works which have been done on the basis of verbal explanation were of better qualities, but required more time. Demonstration has led to worse quality if compared with an explanation, but it was done quicker. The combination of these methods eliminated the mentioned drawbacks and provided quicker fulfilment than in the first case and better quality of work than in the second one. A weak point of this combination was the possibility of their mutual influence upon each other. Trying to better understand and remember the instructions during the explanation, some pupils did not sometimes notice the details before their eyes and, on the contrary, concentrated the attention on the assimilation of the shown objects, missing separate points of the explanation. The difference between explanation and demonstration was also exposed in the methods, used by the pupils in their actions. In the course of the demonstration the pupils imitated the leader and used methods he had shown to them whereas in the explanation the pupils independently used methods they chose though these methods were not always effective.[10]

Other research in polytechnic education—Research is proceeding also to find the interconnection between physics, chemistry, and mathematics, and fundamentals of production. They are also investigating the methods of teaching machine technology, electrotechnics, and automobiles. We were told that the main goal of work at the industrial plants is to teach fundamentals of production in a polytechnic sense.

Researchers go to the plants and study students, workers, proc-

[10] *Ibid.*, pp. 5, and 7–8.

esses, etc. They feel quite strongly that students should know certain theoretical information about the machines, technical processes, and the technology involved.

At the Scientific Research Institute of Psychology, Moscow, we learned that they are doing research dealing with "habits" involved in polytechnic education. One of the researchers is trying to find ways of developing skills of a generalized nature; for example, skill in planning, self-realization, and self-control.

In the Institute of Theory and History of Pedagogy, Moscow, specialists in comparative education are conducting a major study on "Practical Arts Education in General Schools of Different Countries." Some of the countries under study are Bulgaria, England, France, Germany, India, Italy, Japan, Poland, United States of America, and countries in the Middle East. They expressed a keen interest in the place of industrial arts in American education.

Results of some research—As a result of their researches, Soviet educators feel that a student, in the early stages of his schooling, should be given "a lot of words and less scope," and as he progresses he should have "less words and more work" so he can create and use his own initiative more.

One factor important to learning, which is agreed upon all over the world, they say, is *motivation.* If the student knows what his knowledge is good for, then the knowledge is better understood. We were told about an experiment which illustrates this latter point involving two schools in Moscow—one with a garden plot, one without. When the students of both schools were asked similar questions about the earth, sun, and water there were considerable differences in their replies. The students who had worked on the plots gave more meaningful answers than those who had not. Furthermore, Soviet educators find that the work at enterprises has a psychological base. Operating machines at an enterprise help students to understand fundamentals of machines and production.

One of the large educational experiments conducted in the Soviet Union in the last few years dealt first with 50 schools, then with 248; and, as was mentioned before, now about 2,000 schools are on an experimental basis in the R.S.F.S.R. Last year in Ukraine, there were 2,000 experimental classes. The results of these continuing experiments are contributing to the new curriculum reforms being implemented in the Soviet Union at the present time.

The examples of the research reported to be under way at the

time of our visit in the Soviet Union indicates the range and scope dealing with both fundamental and practical problems. Some of their major problems deal with solving the interconnection of various subject matter areas, improving labor training instruction, and relating education closer to Soviet life. The impact of these and other researches, no doubt, will continue to influence Soviet education in the years ahead.

CHAPTER IV

Teacher Education

SOVIET EDUCATIONAL LEADERS firmly state their belief that the key element for sound, effective instruction in the schools is a well-trained, dedicated corps of teachers. To this end they have developed an extensive and rigorous program of preservice and inservice teacher education and training. This program puts heavy emphasis on knowledge of subject matter to be taught but does not seem to slight professional aspects which are designed to enhance the skill of the teachers in imparting this instruction to their pupils.

In imperial Russia there were few teacher training institutions of university rank, although there were many with academic standing of secondary level. Today, however, teacher training institutions constitute one of the largest groups of Soviet colleges. Further evidence of the importance of teacher training in the Soviet Union is the fact that since 1957 the program of training has been lengthened from 4 to 5 years for secondary teachers of grades 5 through 11, and that at the present time the training of elementary teachers for grades 1 through 4 is being changed from programs that are 2 or between 2 and 3 years in length at the pedagogical schools, to a 4-year program in the pedagogical institutes.[1] All of these programs are based on completion of secondary education. As of 1958–59, about 63,400 future elementary teachers were completing studies in the pedagogical schools, while teachers graduating from higher institutes and universities totaled 113,600.

Control of Teacher Education

The primary responsibility for preparation of teachers rests with each Ministry of Education in the 15 Republics. The

[1] See W. K. Medlin and N. Apanasewicz, *Programs in Secondary Teacher Education in the U.S.S.R.*, "Information on Education around the World," No. 9, U.S. Department of Health, Education, and Welfare, Office of Education, December 1958.

U.S.S.R. Ministry of Higher and Specialized Secondary Education, however, exercises certain supervisory responsibilities in this field. It has ultimate control over questions of science, methodology, research, and teaching, and it shares with the Republic ministries of education responsibility for curriculums. This joint control over teacher education aims to insure programs which are of high quality and ideologically consistent.

Annual admission quotas for the day program are established for the entire U.S.S.R. and for each institution separately. Not one student in excess of the established quota is permitted at any institution. There are no quotas for the evening or correspondence programs, which account for 43 percent of the students enrolled in higher education.

Pedagogical Institutes

The primary function of the pedagogical institutes is the training of secondary school teachers; i.e., teachers of grades 5 through 11. A pedagogical institute normally has both internal (regular day) students and external (correspondence or evening) students; in some instances an institute enrolls only day or only correspondence students.

These institutes have been primarily responsible for upgrading the qualifications of secondary school teachers over the past 25 years. This upgrading has taken on particular emphasis during the past 10 years, when length of study as well as enrollments have steadily increased. This process has led to a deeper subject-matter preparation of Soviet secondary school teachers than was possible under earlier programs, where professional requirements in education took a larger portion of students' time, in terms of course work. At the same time, and particularly since 1955, universities have been supplying greater numbers of teachers for grades 5 to 10 in single subject areas. These teachers do not have so much professional preparation as do pedagogical institute graduates. As of the 1958–59 school year, 85 percent of Soviet secondary school teachers had completed a higher education. The importance of the institutes in higher education is evident in their total enrollments: over 500,000 students, or nearly 25 percent of all Soviet students in higher education, attend the pedagogical institutes.

ADMINISTRATION AND ORGANIZATION

Each institution is headed by a director, whose role roughly

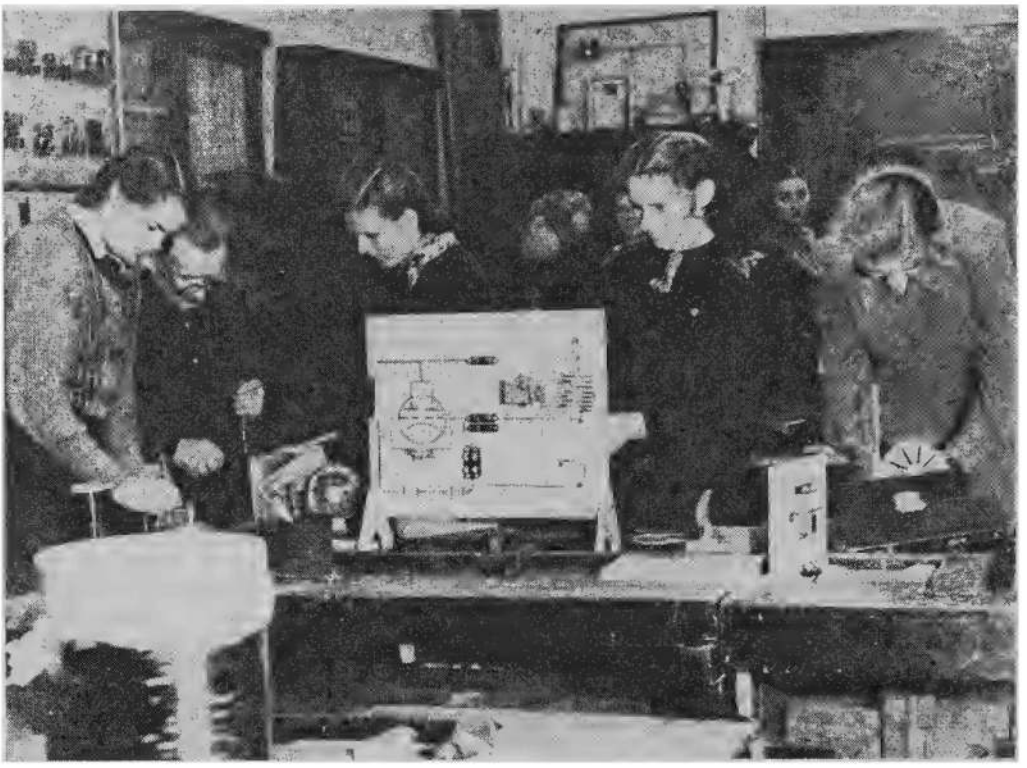

Figure 4-1.—Physics laboratory at Kiev Pedagogical Institute.

corresponds to that of a president of an American college. The teaching staff is organized into faculties, similar to our departments or schools within a college or university. Each department, or faculty, is administered by a dean. The number and types of departments vary from institute to institute, as shown in the list of institutions with their departments, which our group visited. Students are enrolled in one department, but they may take courses offered in a number of departments, depending on their programs of study. The various kinds of "specialties" or majors offered in the institutions visited, and the different offerings and enrollments in the three separate programs (regular or day, evening, and correspondence), appear in table 10.

Organization of Faculties in Pedagogical Institutes Visited

1. Krupskaia Pedagogical Institute, Moscow
   a. Philology
   b. Foreign Language (in process of being disestablished and incorporated into the department of philology)
   c. Physics and Mathematics
   d. Biology, Chemistry, and Fundamentals of Agriculture
   e. History
   f. Physical Education

2. Lenin Pedagogical Institute, Moscow
   a. History and Literature
   b. Geography and Biology (excluding agricultural biology)
   c. Biology (agricultural) and Chemistry
   d. Physics and Mathematics
   e. Defectology
   f. Pre-School Education
   g. English Language
   h. German and French Languages

3. Gor'kii Pedagogical Institute, Kiev
   a. Physics and Mathematics
   b. Language and Literature
   c. Pedagogy
   d. Engineering (pedagogical)

4. Pushkin Pedagogical Institute, Tbilisi
   a. Philology
   b. Physics and Mathematics
   c. History and Literature
   d. Biology and Chemistry
   e. Geography and Biology (excluding agricultural)
   f. Library Science

5. Hertsen Pedagogical Institute, Leningrad
   a. Philology
   b. Pedagogy
   c. Biology and Chemistry
   d. Physics and Fundamentals of Production
   e. Mathematics and Technical Drawing
   f. Geography
   g. Physical Education
   h. Foreign Languages
   i. Defectology
   j. Aesthetic Education

Each faculty is composed of "chairs," each of which is headed by a professor. For example, in the Lenin Pedagogical Institute in Moscow, the faculty of physics and mathematics consists of 9 chairs: General physics, theoretical physics, methods of teaching physics, astronomy, basis of engineering, algebra, geometry, mathematical analysis, and methods of teaching. At the Hertsen Institute in Leningrad there are three chairs in mathematics—mathematical analysis, algebra and geometry, and elementary mathematics and methods of teaching mathematics—and three chairs in physics—general physics, theoretical physics, and the methods of teaching physics.

Table 10.—Offerings and enrollments by type of program in certain pedagogical institutes (1959)

Institution	Day program		Evening program		Correspondence program	
	Specialties	Enrollment	Specialties	Enrollment	Specialties	Enrollment
1	2	3	4	5	6	7
1. Krupskaia Pedagogical Institute in Moscow.	Russian language, literature, and foreign languages; mathematics and mechanical drawing; physics and fundamentals of production; biology, chemistry, and fundamentals of agriculture; geography and biology; physical education.	2,500	[Not indicated]	2,000	History; Russian language and literature; mathematics and physics; natural science; geography; foreign language; physical education.	3,000
2. Lenin Pedagogical Institute in Moscow.	Russian language, literature and history; mathematics and mechanical drawing; physics and fundamentals of production; biology, chemistry, and fundamentals of agriculture; pedagogy and psychology; defectology, Russian language, and literature; defectology and mathematics; geography and biology; foreign languages (English, German, and French).	4,000				
3. Gor'kii Pedagogical Institute in Kiev.	Ukrainian language, literature, and tutoring at boarding school; Russian language, literature, and singing; mathematics and mechanical drawing; physics and fundamentals of production; pedagogy and psychology (preschool); defectology and methods of elementary education.	950	[Not indicated]	100	Ukrainian language and literature; Russian language and literature; mathematics; pedagogy and psychology; defectology.	2,000
4. Pushkin Pedagogical Institute in Tbilisi.	Russian language and literature, Georgian language and literature; literature, and history; Azerbaijan language, literature, and history; Armenian language, literature, and history; mathematics and physics; physics and fundamentals of productions; biology, chemistry, and fundamentals of agriculture; geography and biology; library science; methods of elementary education.	1,908	Russian language and literature; Georgian language and literature; library science.	300	Georgian language and literature; Russian language and literature; history; mathematics; natural science; geography; library science; methods of elementary education.	3,500
5. Hertsen Pedagogical Institute in Leningrad.	Russian language, literature and history; foreign languages (English, German, and French); mathematics and mechanical drawing; physics and fundamentals of production; biology, chemistry, and fundamentals of agriculture; geography and biology; physical education; defectology, Russian language and literature; defectology and mathematics; pedagogy and psychology (preschool department); methods of elementary education. Department of Nationalities populating Northern areas of the U.S.S.R.	6,000	Russian language and literature; mathematics; history; natural science; geography; pedagogy and psychology (preschool department).	3,000	History; Russian language and literature; mathematics and physics; natural science; geography; defectology; pedagogy and psychology (preschool department); physical education; methods of elementary education.	7,500

SOURCE.—*Spravochnik dlia postupaiushchikh v vysshie uchebnye zavedeniia Soiuza SSR v 1958 g.* (Manual for students entering establishments of higher learning in U.S.S.R. in 1958.) Moscow, "Sovetskaia Nauka" 1958, 271 p.; and information given by personnel at pedagogical institutes.

ADMISSIONS

To be eligible for enrollment in the day program in a pedagogical institute, a student must have completed the regular 10-year schooling, or in some instances an equivalent education in a technicum or special secondary school which is a semiprofessional school for the training of various kinds of specialists. The student may apply to one institution only in any one year. Since there is competition for the available places within the established quotas, students usually apply at an institution and for a type of program where they believe they will have reasonable likelihood of success. An applicant who is unsuccessful one year may try another year. Some students have applied two or three times before being admitted. Persons over 35 years of age and not eligible for the day program may apply to the evening or correspondence programs.

Under a new decree issued in 1958, applicants who have had 2 years' experience in production work in industry or agriculture are given preference in the filling of 80 percent of the first-year enrollments. Work experience is absolutely obligatory for those who plan to specialize in journalism, law, and philosophy. Military service is regarded as equivalent to work experience.

Entrance examinations commence on August 1 and last for 10 days. Every student must appear before examining committees and take oral and written examinations in Russian language and literature, and the foreign language studied in the secondary school. In addition, the student is examined by the faculty in which he proposes to study. Applicants who rate highest in the examinations are permitted to enroll up to the limits of the established quota. Classes begin each year on September 1, unless this date falls on a Sunday, and continue until the end of May.

CURRICULUM

Students in the regular day program must take a double (in a few cases triple) major in related subjects. The following combinations may be offered in the pedagogical institutes of the U.S.S.R.:[2]

Russian language, literature, and history
Russian language, literature, and foreign languages
Foreign languages
Mathematics and mechanical drawing

[2] See appendix VIII for the details on the curriculums.

Mathematics and physics

Physics and the fundamentals of production

Biology, chemistry, and the fundamentals of agriculture

Geography and biology

Physical education

Although the programs of study for pedagogical institutes are established by decree which is applicable to all institutes, local training facilities and needs sometimes require modifications of official plans. In practice, therefore, the total number of hours may not be distributed exactly as indicated in the program of study. For the purposes of general study and analysis, however, our observations tend to confirm that the programs as published represent substantially what obtains in all pedagogical institutes in the U.S.S.R.

Subject-matter content in the majors taken occupies the main portion of the curriculum for each student. However, professional education in the art of teaching is considered to be very important. Not only must the students take a year's course in principles of education, called pedagogy (120 hours), and a year's course in the history of pedagogy (72 hours), but also they must take special method courses in teaching the main subjects for which they are preparing. In addition, students during the last 2 years are required to complete a program in supervised practice teaching lasting 16 full weeks (discussed on page 180). Student teaching is performed at schools in the area near the pedagogical institute or in demonstration schools of the institutes which have them.

The curriculum does not offer broad, general (liberal arts) education, the assumption being that the students had received a solid foundation during their secondary education. Under this philosophy, for example, students specializing in foreign languages do not take any science or mathematics; while on the other hand, students specializing in science and mathematics take only a limited amount of the work in the humanities and social sciences area. A good portion of this work is in the field of Marxist ideology and Soviet Communist history.

In spite of having studied a foreign language for 6 years in previous schooling, a student is nevertheless still required to study that language or a new language during 2 years of his college program. He or she may elect to continue to study the foreign language after the second year. Physical education is obligatory for the first 2 years and optional for the remaining years. Also

required of every student are the following subjects: History of the Communist Party of the Soviet Union, political economy, dialectical and historical materialism, psychology, and school hygiene.

If a student has entered a curriculum which later proves unsuitable, he or she may change to another curriculum or to another institution. Even in changing from one curriculum to another in the same institution the student must start from the beginning again. However, this situation is considered inefficient and expensive and seldom occurs.

A significant characteristic of Soviet teacher education is that its programs do not normally lead to a diploma in education but rather in a subject specialty (physics-mathematics, history-literature, etc.). It is possible to acquire a diploma in education (pedagogy), but this program is offered in only a few institutes.

PROFESSIONAL TRAINING FOR NEW TEACHERS

Theory and general methods.—During the first year all students take a course in psychology. In addition, there are visits to schools to make observations and orient the students to their future profession. During the second year, students take a course in pedagogy. An outline of this course is given in the appendix.[3]

In the pedagogy course, the role of the "leading teacher" *(vospitatel')* is introduced. There is one such teacher for each grade, and this teacher is responsible for that part of the school program which concerns the cultural and moral upbringing of the pupils. In addition, this teacher does some administrative work, such as taking care of the class register, the student day book, conferences with pupils, assistance with Pioneer activity, and coordination of field trips and excursions with subject-matter teachers. The "leading teacher" has responsibility for an entire grade, and this role with a particular class of students is not for one year only but extends over several years. Thus, this teacher, who is in effect a class adviser, gets to know the pupils very well.

The importance of "circle" activity and field trips and excursions is stressed in the course of pedagogy. At the Hertsen State Pedagogical Institute, lectures are given on how to conduct tours for children. As an example of the interest shown in "circle" activity, even the director of this institute, a specialist in geography, is the leader of a "circle" in geography and also serves as Chairman of the All-Union (national) Society of Excursion Circles.

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[3] See appendix X.

During the course in history of pedagogy taken in the third year students study the history of education, including the origin and development of pedagogical ideas from ancient times to the present. The main emphasis is on Russian and Soviet education, but the history of education in such countries as England, France, Germany, and the United States is studied briefly as well. The study of education in Western European countries commences with John Locke.

Special methods.—In addition to taking the general courses in the history and theory of pedagogy, each student is required to take a special methods course in each of the two specialties the student is studying. In each faculty there is a chair of special methods. The faculty members in this chair are specialists who combine competence in both subject matter and pedagogy. In special methods courses the students learn specific techniques in teaching various subjects.

Practice teaching.—In the fourth year each student is assigned full-time to a school at which he or she spends 6 or 8 weeks in

Figure 4-2.—School children of experimental school No. 16, Moscow.

practice teaching. The Lenin State Pedagogical Institute in Moscow has 107 schools in the Moscow area which cooperate in its teacher training program. The Hertsen State Pedagogical Institute in Leningrad has three demonstration schools attached to it and has ties with 180 cooperating schools. Usually several students, sometimes as many as 20, are assigned to a school, and each student teacher is placed under a regular teacher who teaches one of the student's specialties. This regular teacher acts as the student's supervisor. The supervising teacher receives extra remuneration for each student assigned to his or her class: 10 or more rubles per hour for each student teacher supervised. Assignments are made mostly to grades 5 through 7, less frequently to grades 8 through 10. During the first week, the student teacher becomes acquainted with the class. In the second week, he or she may give one or two demonstration lessons under immediate supervision. Thereafter the student teacher begins giving regular lessons while still being rather closely supervised by the regular teacher. To assist in the training process a methodologist from the institute makes occasional visits to observe and confer with students and supervising teachers. Methodologists normally are responsible for 12 to 14 students. During the training period, in addition to teaching a limited number of classes, the student teacher acts as the regular teacher's assistant, correcting papers, taking children on excursions to museums and factories, etc.

In the fifth and final year students engage in 8 or 10 weeks of practice teaching in schools to make a total of 16 full weeks in all for each student. The school in which a student does his or her second period of practice teaching may be the same one as in the fourth year or it may be a different one. This second practice period may be scheduled at any time during the school year before April, but is usually completed during the fall term. The student teacher, under the guidance of the supervising teacher, is expected to perform all of the functions of the regular teacher, such as preparation of lesson plans, actual teaching, and marking of the pupils. Practice is also gained in teaching the second subject-matter specialty of the student teacher. Methodologists and other student teachers practicing at the school frequently attend a demonstration lesson of one of the practice teachers and hold critiques soon after to point out strong and weak points and to give suggestions for improvement. Upon completion of the practice teaching assignment each student teacher is required to submit a written account of the teaching experience.

In addition to their regular program of teaching, teachers in

the Soviet Union are expected to direct extracurricular or "circle" activities related to their specialties. This program is conducted during the after-school hours to provide enrichment to the school curriculum and permit the pupils to follow and develop their special interests and abilities. For this reason, student teachers are expected to be prepared to direct such activity and are given training during their school practice period. In addition, each student in a pedagogical institute is required to spend part of one summer (about 3 weeks) after the second or third year in leading activities at a Pioneer camp, which is an out-of-doors recreational program for school youth under overall Communist supervision.

SCHEDULE OF INSTRUCTION

The academic year is divided into two terms: The autumnal term which lasts from September 1 (September 2 if September 1 falls on Sunday) until January 23, and the spring term which begins on February 7 and ends on June 30. The students are scheduled for no more than 36 (usually 32 to 34) hours a week in the first 3 years, 28 to 30 hours a week in the fourth, and 20–28 hours in the first half of the fifth year. The final semester is spent on writing a paper based on elementary research. Students come to the institute 6 days a week for 4 to 6 hours a day during the first 2 years. In the last 3 years they come 5 days a week for 4 to 6 hours a day, which gives them an extra free day besides Sunday.

At the Lenin Pedagogical Institute in Moscow, the classes start at 8:30 a.m. Six academic hours of 50 minutes duration each are scheduled each day. Each subject is always taught during two consecutive periods, with a 5-minute break between periods. There is a 15-minute interval between classes on different subjects. The schedule is so arranged that the lecture portion of the instruction is completed by 12:30 p.m. and the practical studies by 2:15 p.m. each day.

METHODS OF INSTRUCTION

Attendance at lectures and participation in practical exercises are obligatory. Lectures are given substantially according to the State syllabus. Normally each course has its textbook and other required readings to supplement the lectures and provide exercises and problems for the students to do. The books are purchased at relatively modest costs by the students and become their property.

The students are permitted to raise their hands and ask questions, or else they may write questions on a slip of paper to be handed to the instructor. In the college classes which we visited, however, there appeared to be but little interplay between instructor and students during the lecture.

Homework is required in all theory courses. In junior courses, small assignments are given each day based upon the previous lecture and in preparation for the next lecture. In senior courses, big projects or tasks are assigned in which each student is required to do his own planning. The student is allowed a week or 10 days to plan the project and then show it to the instructor, who approves it and who will set a date by which it must be completed.

Laboratory work is required in all science courses. In one second-year general physics laboratory visited we inspected tables with equipment used to perform different experiments. Each student had to complete in one semester 16 experiments, of which 13 were required and 3 were optional. At any one time students would be working on different experiments. Then, they would rotate.

Before doing the experiment the student must read up on it and then make plans for performing it. These plans must be approved by the laboratory instructor. After the experiment is completed, the student writes an account of it and submits it to the instructor. No special mark is given, merely an indication made that the experiment was or was not successfully completed.

After 2:15 p.m. students may have consultations with their instructors, and they may also generally work in laboratories until 8 p.m. Laboratories have their own time schedules. To act in his place during his absence from the laboratory, each science professor or docent has one, two, or three assistants who usually are candidates for higher degrees.

At the Lenin Pedagogical Institute, the library remains open until 10:30 p.m. on each weekday, and from 8:00 a.m. to 8:00 p.m. on Sundays.

Grade point averages, commonly computed in United States colleges and universities, are not determined in the U.S.S.R. The Soviet educators with whom this matter was discussed were surprised at the question, and they saw no value in having a grade point average for each student. They replied that the worth of a student's academic performance could be simply ascertained by an examination of his document. Students with all 5's, or mostly 5's with some 4's, would obviously be the honor students.

EXAMINATIONS AND GRADING

At the end of each semester a student is given a final examination in each main course, not to exceed five subjects. These examinations are quite comprehensive and extend over a period of 3 to 4 weeks.

Quizzes (both brief written type and oral reports) are scheduled for each subject and are given from time to time at the professor's option. Students who have been absent because of illness must make up back work. They may get help from the instructor or other students. Each professor is obliged to schedule 2 hours each week for private consultations. A student may get to see a professor at another time mutually convenient to the professor and the student.

At the end of the fifth and final year a State examination is given. The Ministry of Education publishes for each subject-matter area a list of topics that a student is expected to know.[4] The student is told that he might be examined in any of the topics. An examining committee is set up, consisting of three professors and a recorder. Sets of examination tickets *(bilety)* consisting of three topics or problems are made up by examining committees of each institute in accordance with established requirements.

At the time of the examination, the student is asked to select one ticket from the set of tickets which are placed face down on the table. The student is then given a little time to reflect on the topics and question, after which the examination commences. At the termination of the examination, which may last from one-half to one hour, the student receives a mark: 5 (excellent), 4 (good), 3 (passing), 2 (unsatisfactory), or 1 (failing). An example of the content of one examination, based on ticket No. 11 in inorganic chemistry, which we observed at the Hertsen Pedagogical Institute in Leningrad, follows:

State Examination in Inorganic Chemistry

1. Pauli's exclusion principle and quantum characteristics of electrons.
2. Calcium and its compounds.
3. Allotropy and polymorphism

[4] In appendix XI will be found two examples, one in mathematics and one in physics.

RECORDING OF STUDENTS' PERFORMANCE

Each student has a special booklet (student book) which contains a page for each semester in which are listed the courses taken and the final grade entered by the instructor from whom the course was taken. Students are always graded according to the number system referred to above, whether the work being evaluated is a small amount or pertains to that done during the entire course. On the page opposite the course lists, the completion of any required practical exercises (sometimes called "practicums") is recorded. A duplicate of these records is filed in the institute's administrative office. A student who successfully passes all of the examinations is graduated with a diploma. A student who fails any of the final examinations is not given a diploma, but instead retains his student book which shows the subjects which have been successfully passed. This student may, nevertheless, receive employment as a teacher, but his wages will be lower than they would be if he or she had received a diploma. The student who fails any of his final examinations may, during each of the next 2 years, retake the examinations at the regularly scheduled time at the end of the school year. The student is then reexamined in each subject-matter area except those in which a mark of 5 has been received.

STIPENDS FOR STUDENTS

About 80 percent of regular daytime students in Soviet higher education receive stipends to enable them to finance their education. These are, in effect, State scholarships provided so that students may devote full time to their studies unencumbered by the necessity of having to work on part-time jobs to make their education possible. Thus, pursuit of higher education in the *day program* in the U.S.S.R. is considered as a full-time job, and satisfactory performance is expected. A student who fails to measure up to the minimum standards loses his stipend and may be dropped from the program.

Following is the schedule of ordinary stipends for a student in a pedagogical institute:[5]

Year of studies	*Amount in rubles per month*
First	220
Second	240
Third	265
Fourth	290
Fifth	330

[5] The official Soviet commercial rate of exchange is 4 rubles to 1 dollar; the rate of exchange for an American tourist in the Soviet Union is 10 rubles to 1 dollar.

Students who receive high marks in all their courses are eligible to receive honor stipends which pay 25 percent more than the ordinary ones. These stipends, which are fairly common, may be received anytime after the first semester. Students who are truly outstanding may even receive higher amounts. These stipends are given in the name of some famous Soviet leader, past or present. For example, the Stalin stipend pays 800 rubles a month, and is usually awarded during the third or fourth years, although it may be received as early as the second year.

The stipends for students studying in the faculty of defectology are 50 percent higher than the corresponding ordinary stipends. Soviet educators explained that this differential was attributable to the more difficult and unpleasant work encountered in dealing with backward children and also to the need for a stimulus to encourage students to elect study in this area. Likewise, it was pointed out that stipends are not uniform throughout all higher education in the U.S.S.R., differing somewhat according to the type of program or higher school. Stipends at certain technical institutes, for example, are higher than the stipends at pedagogical institutes. Thus, a powerful system of incentives is used to encourage students to enter certain branches of higher education

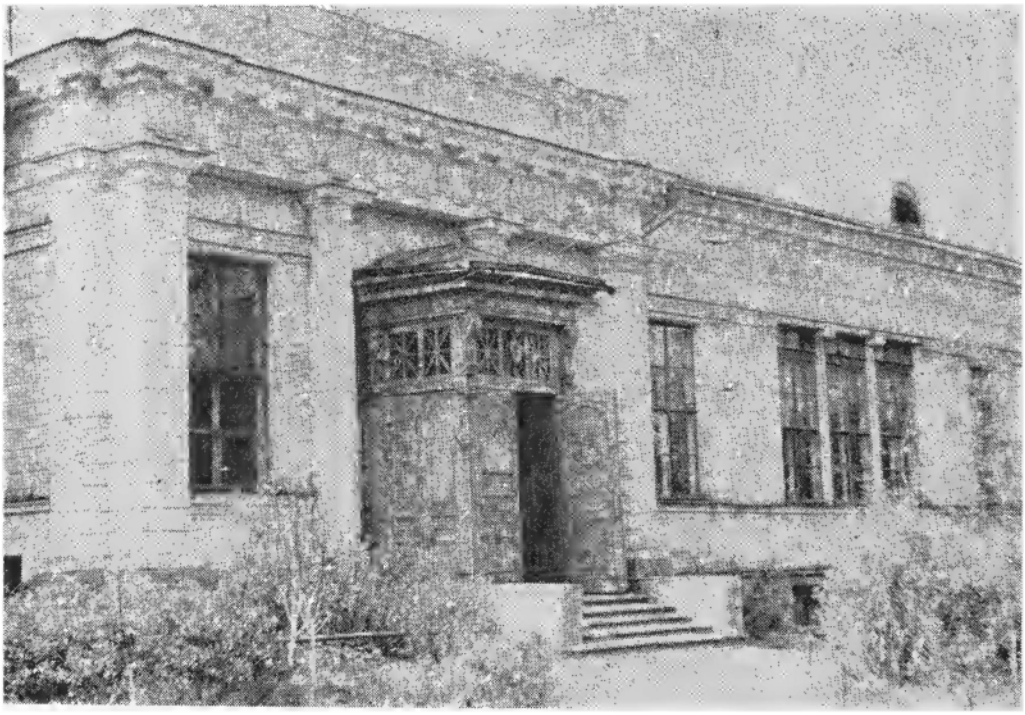

Figure 4-3.—Krupskaia State Pedagogical Institute, Moscow.

on which high priority is placed, as well as to motivate them to achieve their maximum potential in studies.

The stipends received by Soviet students, ranging from $22 a month up, may seem small by United States standards. However, in the U.S.S.R. this amount of money is sufficient usually to take care of all of the student's expenses, such as meals, lodging if away from home, purchase of books and supplies, incidentals, and even a little money for entertainment. Students whose parents assist them financially while at college may use stipends for cultural purposes or "pocket money." There are no medical or dental expenses, as these are furnished without direct cost to all Soviet citizens.

STUDENT LIFE

Although the primary emphasis is on the academic program of the institute, other aspects of student life are not ignored. There are clubs and cultural activities, such as chess clubs, plays, orchestras, outings, etc., in which students can follow and develop special interests and talents. There are also intramural and extramural athletic activities for the students, such as gymnastics, volleyball, ping pong, football (soccer), basketball, and track. Gymnasiums and athletic fields are provided for these purposes. Athletic competitions, involving the best athletes, are held with other institutions, and interested students turn out to cheer their teams.

Canteens, snack bars, and lounges are provided so that students may meet together socially. Students who do not live at home are housed, facilities permitting, in hostels or dormitories. Women and men may live in the same hostel though they will generally be housed on different floors or in different parts of the building. A room arranged for washing, ironing, and some cooking is usually provided in the hostel.

COMPOSITION OF THE STUDENT BODY

Better than 80 percent of the student body in the day program of the pedagogical institutes we visited were women. Soviet educators explained that the men had a greater interest in enrollment at a technical institute. At the Lenin State Pedagogical Institute about 90 percent of the students were women. Examples of the approximate percentages of women enrollment in specific faculties of this institute are the following: Foreign languages, 97 percent; history and literature, 92 percent; physics and mathematics, 80 to 85 percent.

GRADUATION AND JOB PLACEMENT

Annually at the end of the school year in June a graduation ceremony is conducted at which diplomas are awarded to those graduating from the undergraduate program. At the same ceremony graduate degrees are conferred. No special ceremonial dress, such as a cap, gown, or hood, marks this occasion for either the graduates or the faculty. A special speaker, usually an official from the Ministry of Education, gives an address and offers congratulations ot the recipients of diplomas and degrees.

Each graduate is assured a teaching position. Several months before graduation a list of available positions is made known to the future graduates. They may apply for the positions they prefer. In recent years there has been a heavy demand for teachers in such rapidly developing areas as Siberia. If quotas in these areas are not met voluntarily, it is necessary to assign some of the graduates to them in accordance with the State requirements.

TEACHING STAFF

Rank and salary.—The teaching staff at a pedagogical institute, as in all institutions of higher education in the U.S.S.R., consists of three ranks: Assistant *(assistent)*, docent, and professor. The average wage of an assistant with 5 years of teaching experience is 1,700 rubles a month; and with 10 or more years of experience, 2,500 rubles. A docent with 10 or more years of experience receives 3,200 rubles a month, which is the maximum wage of a docent. Salary increases for an assistant or docent occur only at the completion of 5 and 10 years of experience as a teacher. A professor receives anywhere from 4,000 to 5,000 rubles a month, depending upon his highest graduate degree and the number of years of experience as a teacher. A salary of 5,000 rubles, or roughly $500 a month, is considered a very good wage in the Soviet Union.

Assistants are chosen from among the outstanding graduates of the 5-year program of Soviet higher education. The best students are encouraged to stay on as assistants and at the same time continue their studies as *aspiranty* (aspirants for the first graduate degree) in the postgraduate program of the institute, to seek the degree of *kandidat* (candidate). This degree is in some respects close to a Ph.D. degree in the United States and is awarded at the end of not less than 3 years of postgraduate study. The possession of the candidate degree will entitle the holder to qualify for the rank of docent (similar to associate professor) on the institute teaching staff.

The rank of professor is usually awarded only to those who have the doctor's degree. The doctor's degree is conferred upon the relatively few who have made major contributions to research and the advancement of knowledge. This honor may be earned soon after achieving the candidate degree, or it may take many years. To receive a doctor's degree, the candidate for this degree must have the results of his work published. He then defends it before a selected academic council which has the right to confer doctor's degrees. The decision of the council is based on a vote taken by secret ballot. The decision to confer a candidate or doctor's degree is subject to confirmation by the Supreme Qualification Commission of the Ministry of Higher Education and Specialized Secondary Education of the U.S.S.R.

Work loads.—The teaching loads of teachers are generally as follows: Professors—6 to 10 hours per week; docents—12 to 14 hours per week; and Assistants—16 to 18 hours per week.

At the Krupskaia State Pedagogical Institute there was one faculty member per 10 students in the regular day program, and one faculty member per 70 students in the correspondence program.

Besides the teaching load, each faculty member is expected to have research work in progress. Two months of vacation are granted each year to each faculty member.

Faculty members may, like anyone else, write textbooks and seek to have them adopted by the Ministry of Education. Many faculty members are successful in this endeavor of writing textbooks for all levels of education. For each 17 pages an author may receive anywhere from 1,000 to 3,000 rubles depending upon the quality of the book. The chairman of the geography chair at one of the inservice institutes for teachers in Leningrad recently received 38,000 rubles for a primary school geography textbook that he wrote. If later reprints are made of his book, he will receive additional compensation.[6]

Selection.—The academic council determines whether or not a professor is capable of holding a position. This determination depends in part upon the competition for the position. Every 5 years a position is open for competition, usually in April or May. A special competition council in the chair concerned is set up, and an announcement is made in the newspapers that competitions for certain positions will be held. Candidates apply to compete for certain positions and submit their qualifications in

[6] Royalties for authorship of books are described in L. A. Karpov and V. A. Severtsey, *eds.*, *Vysshaia shkola, (The higher school)*, Moscow, "Sovetskaia Nauka," 1957. P. 635.

terms of experience, research, and publications. The winner of the competition is chosen by the council in a secret election. The incumbent in the position more generally wins than not.

By the competition procedure each institution thus attempts to employ the best teachers available. If an incumbent loses out in the competition, he usually goes to another institution where the staff is less qualified. The Ministry of Education attempts to give each professor so displaced a job somewhere else.

Retirement.—In Soviet education there is no compulsory retirement age for teachers. A professor may work as long as he wants and is able, provided that he can demonstrate in open competition with others who may desire his position that he is the best qualified. Professors aged 80 or 85 years old are not at all uncommon. A professor may retire at age 60 at an average salary of 2,000 rubles a month. The professor, however, may choose to continue working, in which case he or she is paid the regular salary for the position and draws the retirement pay in addition to this salary.

Training of faculty for pedagogical institutes.—In addition to its program for training teachers for the general schools, a pedagogical institute will usually have a postgraduate program, the primary purpose of which is to continue the education of those students whose academic achievements indicate that they are good prospects to become future docents and professors.

Each faculty of the pedagogical institute conducts its own postgraduate program, and each chair in the faculty commonly has two or three postgraduate students *(aspiranty)* attached to it. Each aspirant has an individual program planned for a 3-year period. This program may involve further advanced course work in the specialty area. The aspirant receives further practical training as a teacher by working as an assistant but is not required to take any further course work in professional education, although he may enroll in a class. A thesis is required. This thesis must be a major project and must be defended at a public hearing before a selected committee of examiners. An aspirant who successfully completes all the requirements is awarded the candidate degree.

Postgraduate work may be taken by correspondence study. In this case, however, completion of the program normally requires 4 years rather than 3.

At the Lenin State Pedagogical Institute in Moscow there were in the 1958–59 academic year a total of 220 full-time aspirants

Figure 4-4.—Experiment in physics laboratory, Kiev Pedagogical Institute.

distributed among the 45 chairs of the institute. At the commencement exercises of June 1959, between 25 and 30 of these were scheduled to receive their candidate degrees. An additional 25 aspirants had finished their course work but were not eligible for the degree until the completion of the thesis requirement. At the same exercises, five or six doctor's degrees were scheduled to be awarded.

Training of Teachers for Polytechnic Education

The men and women who teach polytechnic education in the general schools have come from various sources: (1) The 5-year pedagogical institutes; (2) universities; (3) skilled workers; and (4) graduate engineers. In chapter III, data was given on some of the educational backgrounds of polytechnic teachers with whom we talked. An increased effort is now being made by Soviet educators to have greater numbers of future teachers specifically trained to do this kind of teaching.

The close relationships between mathematics, sciences, and polytechnic courses are reflected in some of the teacher-education

programs: Physics and the fundamentals of production; mathematics and mechanical drawing; biology, chemistry, and the fundamentals of agricultural production; biology, geography, and the fundamentals of agriculture.[7] Practical inservice training is provided future teachers of these specialties in factories, repair shops, electric plants, machine-tractor stations, etc. In the curriculum of physics and the fundamentals of production, out of a total of 4,530 hours the student spends 1,904 hours in lecture, 1,198 hours in laboratory, and 1,428 hours in practical work.

The new emphasis on polytechnic education is making itself felt still further in some of the training programs at pedagogical institutes. At the Gor'kii Pedagogical Institute in Kiev, we were told that they were organizing a new faculty in 1959–60 to be called the "Faculty of Engineering Pedagogics." Teachers of senior secondary grades will be trained by this faculty, and the graduates will have approximately the same technical education as an engineer. To facilitate this new training the institute is planning to expand its own workshop facilities. We observed classes in technical drawing and radio, and we visited the metalworking, woodworking, automobile, and electrotechnic workshops.

At the Hertsen State Pedagogical Institute in Leningrad a new faculty is also being established to train a new kind of teacher for the 8-year school. These teachers will conduct courses in drawing, technical drawing, and labor training. The present faculty of physics and fundamentals of production will continue to train teachers for grades 9, 10, and 11. They are also experimenting with a new combination program—physics and electrotechnics. The graduates of this new program will teach courses like machine study, electrotechnics, radiotechnics, automobile, and tractor. We visited the laboratories and shops for radiotechnics, general physics, electrotechnics, metalworking, woodworking, automobile, and tractor. This pedagogical institute is expanding its present laboratories by about 50 to 60 square meters, and a whole wing of a building will be devoted to physics.

At Pedagogical School No. 2 in Moscow, we saw newly designed single-place, wooden desks for the use of third and fourth grade pupils in the demonstration school. These desks, we were told, were good for manual arts work. Prospective primary teachers in this school are required to take practical work in the school workshops 2 hours a week during each of the four terms of their training program.

Polytechnic emphases in the Soviet general elementary-

[7] See appendix VIII for Curriculums.

secondary school are causing a minor "pedagogical revolution" in the training institutions for teachers. New concepts, new methods, new facilities, and new "products" are now in full course of development.

Pedagogical Schools

The pedagogical schools have long existed to train teachers for the elementary grades 1 to 4. These schools, which offer only a 2-year program and which are not considered to be at the higher education level, are passing out of existence as teachers go for training to a 4-year program of a pedagogical institute. Indicative of this trend is the fact that, whereas in Moscow there were eight such schools a few years ago, there are only two operating at the present time. Although there were 280 schools as of 1957, the trend has been steadily to upgrade the programs to 4 years, especially in the large cities.

We had opportunity to spend a half day at Pedagogical School No. 2 in Moscow. There were 530 students enrolled in this school, of whom only 7 were young men. The staff consisted of 66 teachers, including 6 teachers of foreign languages and 18 teachers of music. A demonstration school, attended by neighborhood children, was attached to the school in order to provide practice teaching experience conveniently for the students. The curriculum of the school covers a variety of subject matter because an elementary teacher teaches all the subjects in a grade. In tune with the new emphasis in polytechnical education all students are required to take practical shop work. This experience includes work in the artistic (paper, clay, etc.), woodworking, and metal shops. Aided by this training the students are considered to be better prepared to teach to their future pupils the rudiments of socially useful work.

For their professional training in pedagogy, students spend a whole day each week during the first semester of the first year in observation of teaching at the demonstration school. During the second semester each student performs demonstration lessons after the lesson plans have been approved by a methodologist.

During the summer between the first and second years, each student is required to spend a minimum of 15 days at a Pioneer Camp in order to learn how to direct this kind of activity.

During the first semester of the second year the student engages in one full week of actual teaching which is supervised by the regular teacher of the class as well as the methodologist. Then in

the final or fourth semester, 4 full weeks more are devoted to supervised practice teaching.

Upon completion of the 2-year program the graduate receives a diploma which certifies him or her to teach in the elementary grades. The salary for a beginning elementary teacher is 575 rubles a month and is less than that paid to secondary school teachers who require more educational training. This salary is based on the weekly teaching load and does not include benefits or income received by other educational or administrative activities and work outside school.

Only the best students, up to 5 percent of the graduating class, are permitted to enter the day program of a pedagogical institute as *first year* students. The rest of them become teachers. These teachers may, if they so desire, enroll in an evening or correspondence study program of a pedagogical institute while they are teaching. A large percentage of the evening and correspondence study enrollment in pedagogical institutes consists of such teachers.

University Programs for Teacher Training

Future teachers for Soviet schools are trained in the universities as well as in the pedagogical institutes and pedagogical schools. However, at the universities the program is more subject-matter oriented and there is considerably less emphasis on professional preparation of teachers. For example, chairs on methods of teaching do not exist in the universities. Curriculums at Moscow University and other higher institutions, designed for preparing persons qualified to teach high school subjects, are available in various sources.[8]

Students in universities are divided into two major classifications—the natural sciences and the humanities. The majority of the graduates in the natural sciences go into research and industrial work. Of the graduates in the humanities about 60 percent become teachers and about 40 percent enter into nonteaching careers.

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[8] For material on university programs, see W. K. Medlin and N. Apanasewicz, *Information on Education Around the World*, No. 9, Washington, U.S. Department of Health, Education, and Welfare, Office of Education, pp. 28–32; American Society for Engineering Education, *ASEE Engineering Education Exchange Mission to the Soviet Union* (reprint from *Journal of Engineering Education*, Vol. 49, No. 9, 1959, pp. 890–910); and Edward M. Corson, "*An Analysis of the 5-year Physics Program at Moscow State University*," in *Information on Education Around the World*, No. 11, Washington, U.S. Department of Health, Education, and Welfare, Office of Education, Feb. 1959.

Correspondence and Evening Programs for Teacher Training

Correspondence study and evening study are widely used forms of higher education in the U.S.S.R., consisting of over 40 percent of all students enrolled. The reasons that these types of instruction are so well patronized are several.

First, not all those who apply can be admitted to the regular day program because of the quota limitations, whereas there are no quotas for correspondence or evening study. Likewise, there is no age restriction for correspondence or evening study; while 35 is the maximum age for admission to the day programs.

Second, under a new law requiring that 80 percent of the new admissions to the day programs in higher education have had 2 years of practical work experience, students generally want to keep active in study and thereby improve their chance of admissions to the day program when they are eligible.

Third, since individual advancement and success in the Soviet Union depend to a considerable extent on educational attainment, there is strong incentive for each person to go as far in education as his or her capabilities permit. In the teaching field, there are great numbers of teachers who have not completed diplomas. Elementary teachers, most of whom have had only 2 years of preparation, earn less than the secondary teachers who require longer training. Many of these teachers are seeking to qualify for better positions through advanced study. The correspondence and evening programs enable them to do so while they are continuing in their present jobs.

An example of the magnitude and scope of the correspondence and evening programs is the program carried on by the Krupskaia Pedagogical Institute in Moscow, which has a combined evening-correspondence enrollment of 5,000 and a daytime enrollment of about 2,500 students. In the evening program alone, there were 2,000 students enrolled. Those students living in the Moscow commuting area come to the Institute two or three evenings a week and all day on Sunday.

There are 3,000 students enrolled in the correspondence program at Krupskaia Pedagogical Institute who live outside the Moscow commuting area. Five years are required to complete a specialty and receive a diploma. The correspondence courses are the same as those required of students in the regular program, with the exception that only one specialty or major is taken. This arrangement naturally limits the number of subjects an individual cor-

respondence student completes, as compared to a regular student. But the unified character of the curriculum in both programs ensures that the material covered in all required courses will be the same. Thus, a correspondence student enrolled in a program leading to a diploma as a teacher of foreign languages will cover the same material and meet the same requirements as day students. A diploma earned through correspondence or evening study is considered to be of equal value, for a specific specialty, to that earned through the regular day program.

In order to form a direct pedagogical link between the institute and correspondence students, "consultation points" are established in the rural areas. The Krupskaia Institute has eight such points. Every student is attached to one of these. Each week, on Saturdays and Sundays, the regular professors of the Institute go out to these points to give lessons of a summary or review nature and to offer special assistance to students. About 200 attend these sessions at each point. Normally between five and seven professors, according to a schedule, go out together on consultation during any one weekend. Depending on the way in which each "chair" at the Institute is organized, professors have a teaching program, part of which usually includes correspondence teaching. Travelling expenses are paid, and pay for the teaching service is taken into account in the professor's regular salary.

Figure 4-5.—Physics laboratory, Lenin Pedagogical Institute, Moscow.

Libraries related to the courses offered are established at each consultation point for students' use. For each course, students are required to submit one written examination done at home, which covers the essentials required in the regular program. Correspondence students come to the Moscow Institute twice during the year, from January 1 to 10, and in the summer months from June to August for a period lasting 35 to 40 days. During these periods they are required to do practical work, laboratory assignments, and examinations. Review lectures are also given. Special leaves from regular jobs are granted for these trips, and students are offered lodging in hostels, free of charge.

Although we were unable to visit any of the consultation points to observe the educational work going on there, we were impressed with the apparent organization and control of this large correspondence education program. It appears that Soviet teachers institutes are providing educational opportunities to thousands of rural persons and also to teachers who wish to upgrade their qualifications. Most of these correspondence students have already had some post-secondary education. Very few students enter the 5-year diploma program with only a 10-year maturity certificate. Actually, the majority of the correspondence students hold 2-year diplomas in elementary education or the old (now defunct) 2-year diploma entitling them to teach at the secondary level.

Correspondence programs also provide graduate studies. The duration of the postgraduate program is 4 years for correspondence students, rather than the 3 years for the regular day students.

Inservice Institutes

Great stress is placed on the inservice training of teachers in the Soviet Union. Toward this end a considerable number of inservice institutes have been established throughout the U.S.S.R. At least once in every 5 years teachers are urged, though not required, to take this kind of refresher training.

A typical inservice institute for teachers is the one we visited in Leningrad, a city with 23,000 teachers and 460 schools. This institute, which has eight faculties, 14 chairs, and six special departments is staffed by 109 teachers, and has as its objective the improvement of the subject-matter knowledge and the teaching skills of teachers. The inservice programs are of four types: (1) Academic-year courses; (2) summer courses; (3) seminars; (4) conferences.

ACADEMIC-YEAR COURSES

During the academic year regular courses of instruction are given 6 hours a day, 6 days a week, from the first of September to the first of June. Teachers who attend the institute are given time off, with pay, from their regular teaching jobs one day a week in order to attend the institute. They each take three subjects, and at each meeting each subject is taught for 2 consecutive hours. The program of instruction covers the following: (1) Theory of pedagogics; (2) subject matter knowledge; (3) methods; and (4) teaching practice (demonstrations). At the end of the year, each teacher must write a paper concerning the experiences and training acquired.

SUMMER PROGRAM

Summer courses of a month's duration are given each year from the last part of June to the last part of July. Approximately 3,500 teachers annually receive training at this institute during the academic year and summer programs.

SEMINARS

Teachers who are unable to attend the institute on a regular basis may attend one of the numerous seminars on different subjects and problems. In 1958–59 there were 137 such seminars held at this institute. Teachers come to these seminars twice a month. They read the pertinent literature, prepare papers, make presentations, etc. The seminars are directed by professors from this institute, other pedagogical institutes, universities, or pedagogical research institutes. Frequently lectures are given by guest specialists. One of the advantages arising from attendance at a seminar is the opportunity for the participants to receive consultation from the professors at any time. At the end of the seminar program the teachers write accounts of their experiences and submit them. The outstanding ones are put on exhibition.

CONFERENCES

In addition to the seminars, major conferences on theoretical and practical matters in education are held to enable teachers to exchange experiences, learn of new developments, read papers, etc. The conferences are usually held in March or April during the vacation period.

The essentially "grass-roots" approach which is being used by the inservice institute with large bodies of experienced teachers evidently has a substantial impact on Soviet educational practice.

New theories, for example, are tested and discussed. New textbooks for which adoption is being sought are evaluated, tried out, and criticized. The findings are forwarded to the appropriate authorities to assist them in making their decisions.

One of the principal problems of this institute at the present time is that of working out suitable programs of industrial work experience for pupils in the regular schools as a result of the new emphasis on polytechnic education. To achieve this goal the institute has set up a Technical Council composed of representatives of the institute, the local economic council *(sovnarkhoz)*, the local trade union, and the Russian Academy of Pedagogical Sciences.

Another area of current concern at the institute is the program of rapidly expanding "boarding schools." In 1956–57 in the Leningrad area there were 7 such schools; in 1957–58, 12; in 1958–59, 15; in 1956–60, 39. In the period of 1960 to 1965 it is expected that the number of "boarding schools" in the area will increase to about 150, with an enrollment of over 58 thousand. The announced national goal of pupils enrolled in boarding schools in the entire U.S.S.R. by 1965 is 2½ million. Many of the teachers at this institute have spent considerable time at the boarding schools in order to observe them in action and appraise the relative effectiveness of their programs.

Teachers who take courses of instruction at an inservice institute have examinations during and at the end of each course. Certificates are awarded at the completion of the program of instruction. Even though a teacher may not possess a diploma, he or she can receive no credit applicable toward it from an inservice institute. Such credit can only be obtained through enrollment in a regular pedagogical institute or university.

LOCAL SCHOOL PROGRAMS OF INSERVICE TRAINING

An interesting example of inservice training of teachers at the local school level is that at School No. 204 in Moscow. Here an academic board has been set up consisting of the director (principal), all the teachers of the school, and the chairman of the parents' committee. One function of the board is to plan the "inner life" or activity program of the school for the year. The second function is to discuss effective teaching methods. Experienced teachers are called upon to help inexperienced teachers. If reports come in that a teacher is not doing a good job of teaching, members of the board attend classes of that teacher and try to bring about improvement.

We were told that there are two supervisors in this school who supervise the work of the teachers daily. Frequent meetings are held between the mathematics teachers, between the science teachers, etc., to discuss common problems and to improve coordination of programs.

Pedagogical Readings

The various Republic ministries of education support an annual program of competitive teacher reporting on experiences, innovations, and contributions of various kinds in the cause of education. The forum for these competitive reportings is usually a pedagogical institute or inservice institute, where the papers written by teachers are read and judged by committees of experts and authorities in the field of education. The best papers emerging from local districts are submitted to Republic competitions for further hearing and sifting. Finally, the papers judged to be outstanding at this level are entered in the national competition held in Moscow under the auspices of the Russian Academy of Pedagogical Sciences. Most winning papers in Moscow are eventually published, while others are put on display as examples to teachers and students.

We examined many pedagogical readings that were on display, in various educational exhibits, and some of them were particularly impressive in length (50 to 100 pages), form and quality, and interest. Most of the readings appeared to be on methodology. Authors of winning papers naturally earn publicity, royalties, and often become nominees for State awards like "merited teachers," which bring additional material and prestige benefits.

CHAPTER V

Conclusions

OUR STUDY is not a comparative one of the Soviet and American systems of education, nor is it an attempt to evaluate the schooling and teacher education provided in the U.S.S.R. To accomplish both of these tasks, it would require, *first*, an extensive and intensive investigation into every subject area at every level of the educational structure, in order to establish an inventory of quantity and quality, and *second*, research into the historical, philosophical, social, and economic foundations of the two societies from which the schools are created and which they must serve. Any other "comparison" must necessarily be a general listing of differences derived from differing cultural patterns. This latter exercise can nonetheless be useful and be made to abide by scientific methods.

We have aimed here to provide the interested reader with a document based on our own studies of, and experiences in, the Soviet Union's educational domain. We have also drawn on those of others. Our efforts are buttressed by official Soviet views, educational materials in daily use, and Government statements. With special attention to the sciences and polytechnic training, we have presented factual materials which carefully describe these curriculum areas. This approach has enabled us to become further acquainted with Soviet educational practices, and to point out what appear to us to be some of their strengths and weaknesses. While we tend naturally to be influenced by our own cultural experiences in making these observations, we attempt to place them within the Soviet context. The reader is invited to consider these observations.

The School System

Building on modest but strong foundations, educators in the Soviet Union have erected, in a little more than one generation, a system of mass education. Soviet general education is a vigor-

ous and dynamic institution, embracing, until the 1958–59 reforms, the traditional curriculum patterns characteristic of various European schools. It is in form a 4+3+3 (or 7+3) system, with differentiation of pupils at the end of grade 7. The system seems to be designed mainly to provide higher institutions and technical schools with students well grounded in basic mathematics, science, and the mother tongue. Students admitted to higher education include the best ones, determined on a merit (subject-matter achievement) basis. Perhaps the outstanding feature of the system is its trend in recent years toward offering complete secondary education on a mass basis and with a dual purpose—academic and polytechnic. Partly to improve on the opportunities available to all Soviet children aspiring to complete secondary education, and partly to respond to State needs and to weaknesses in the old curriculum, Soviet educators are adjusting their school structures to render them more practical for their society and more accessible to all children. Thus two major aspects of the system stand out: Mass education on a scale hitherto not practiced in Europe and Asia (for the U.S.S.R. is a Eurasian country); and advancement by children through a unified school establishment or "ladder" system in accordance with their individual capacities and, within State-specified limits, their preferences. The changes now underway are considered later in this chapter.

The Teaching

Until recently, the major emphasis in schools has been on formal methods of learning and teaching. Teachers have aimed primarily to give children measurable quantities of fact-learning. A unified curriculum was designed for the academic preparation of pupils going toward higher institutes. Classroom methods of long-established use, like the textbook and recitation, have occupied the center of pedagogical work. Controlled by centralized forms of political authority, this formalism has functioned as an instrument of the authoritarian philosophy of education practiced in the Soviet Union. Coupled with a program of ideological indoctrination, this situation has apparently tended to hinder creative and self-conscious activities among children, activities which might emerge from practicing other pedagogical ideas. Teachers are, on the whole, skilled in the use of their methods and knowledgeable in their respective subject areas. Consistency ap-

pears to reign and to produce satisfactory results for the purpose of Soviet education.

Circles

Classroom teaching is supplemented in many effective ways through circle (club) activities in the Pioneer organizations. School formalism yields to pupil interests and talents in these after-school hours, and so provides a certain balance in the overall education, at least for some children.

The Curriculum

The curriculum is unified, the same for all schools in the country. Slight variations occur in non-Russian nationality areas in literature, history, and geography. Subjects are taught in parallel sequences over a period of years, rather than in concentrations at different levels of the educational ladder. While the parallel method of instruction may allow for more flexible treatment of subjects and interrelationships with other subjects than do some other methods, there are potential disadvantages of limiting the level of maturity achieved in a given branch and of making impossible a flexible program of electives for serving varied interests and specialties. Some evidence of limited maturity was seen in the social studies work carried on in Soviet schools. The question is, however, admittedly open to more extensive research.

We found that Soviet schools offer strong, basic education in mathematics and sciences. The mathematics curriculum in particular is designed to prepare youth for specialization in engineering and scientific work. According to our observations, their programs in mathematics, physics, chemistry, and biology are roughly comparable to those given in American high schools where students take a mathematics-science oriented curriculum in the college preparatory program; but the main difference lies in two areas: First, in the U.S.S.R., all graduates of the Soviet 10-year school receive the same amount of mathematics and science instruction, whereas in the United States some of the same subjects which are *required* of Soviet youngsters are *elective*. Secondly, the Soviet curriculum advances the pupil, especially after grade 5, at a faster rate in mathematics and science concepts than do the usual American high school curriculums. From these standpoints, Soviet high school pupils may appear to have on the average a

better grounding in fundamentals of science and mathematics than do their American counterparts on completing secondary education; but we see these differences primarily as differences in *emphasis,* not necessarily as a difference in the adequacy of mathematics and science preparation for the respective societies. Many American high school science programs are richer and broader than the Soviet curriculum. Each school system has curriculums designed to prepare youth for living in the conditions of their own country. Likewise, each has identifiable strengths and weaknesses within those contexts.

As a kind of diversification from the unified curriculum, Soviet educators encourage pupil participation in the Pioneer circle activities, which in their subject- and cultural-centered programs, provide opportunity for development of talents. We wish to emphasize particularly this aspect of their program, its facilities, organization, and apparent successes. In addition to offering this creative and formative *foyer,* Soviet educators are beginning to provide other afterschool classes for curriculum enrichment, especially in the sciences.

Trends in Soviet curriculum development are definitely toward introducing vastly increased practical and life-related experiences for children and youth during their entire educational career. The aim appears to be twofold: To facilitate mastery of the mathematics and sciences subjects; and to inculcate on pupils an interest in, and respect for, labor. In regard to the practical applications of theory, the Soviet trend contrasts with that in the United States. Some leading American science educators are advocating that teachers pay less attention to application and give greater emphasis to understanding basic scientific principles. There is considerable ferment concerning American mathematics curriculum, and work is going on with the objective of introducing curricular reforms consonant with modern trends in mathematics problems and thinking. We did not detect this particular trend in Soviet education, although their educators do speak about the need to modernize instruction in mathematics and sciences.

Physics curriculum offers another example. For several years the Physical Science Study Committee, with headquarters at the Massachusetts Institute of Technology and supported by a grant from the National Science Foundation, has been working on a revision of the physics curriculum in the high school. A number of physicists working in collaboration with high school teachers have produced curriculum materials which are designed to develop understanding of basic concepts and principles. In this material,

technology, which is the application of science, receives secondary emphasis. It is the belief of the Committee that once the basic understanding of physical notions has been achieved by the pupil, it will be easier for him to comprehend the specific applications later in life as he encounters them. The Committee has felt that in past years too much attention has been given to specific applications, such as the way a refrigerator operates. Numerous similar examples could be cited.

The Soviet school's curriculum in mathematics-science seems comparatively stronger than its social studies-humanities curriculum, with the probable exception of Russian language education and training in the arts. While our mission did not aim to cover the social sciences or arts, opportunities for some observations did occur. Coupled with knowledge of Soviet syllabus and textbook material in this area,[1] these visits left us with an impression that there are shortcomings here, especially in regard to scientifically derived information about other peoples and their cultures. At the same time, ambitious programs are well underway in the teaching of foreign languages.

Teacher Training

Soviet education is moving steadily toward 4-year program of elementary teacher training and has a 5-year program in secondary teacher education, both at the higher (college) level. The 2-year pedagogical school is disappearing, and the universities, as well as the 5-year pedagogical institute, are preparing important segments of secondary school teaching personnel. Soviet secondary teachers (i. e., from grade 5 up), and increasing numbers of elementary teachers, are therefore now receiving preparation similar in time period (but not in total hours) to that now received by corresponding American teachers. While the secondary teacher in the U.S.S.R. receives more instruction in subject-matter areas than does his average American counterpart, we noted certain deficiencies in the general education taken by the Soviet student. Professional training and practice in pedagogy are provided by Soviet programs in considerable measure, but we did not have opportunities to observe student teachers in action. According to criticism by some Soviet educators, facilities for, and the carrying out of, student practice need improvement.

[1] For example, see W. K. Medlin *and* others, *The Teaching of Social Sciences and Humanities in Soviet Schools.* U.S. Department of Health, Education, and Welfare, Office of Education. Washington: 1959, 49 p.

All graduates of the 5-year programs must write a thesis and pass a State examination in addition to passing regular course tests. Considering the entire teacher education program, our opinion is that, except in the field of general education (liberal arts), the Soviet secondary teacher graduating today has a level of preparation about equivalent to that achieved by a graduate from a 5-year program in an accredited American university or college. Up until the present time, the Soviet student has required 15 years to complete his program; the American, 17 years. We note, however, that Soviet schools are increasing their primary-secondary program to 11 years. It should also be remembered that the school work in the U.S.S.R. goes on 6 days, compared to 5 days in the United States.

In connection with this observation, we wish to point out that in the United States the trend is to require 4 years of college-level preparation for elementary as well as secondary school teachers. At the present time the average classroom teacher in the public elementary and secondary schools of the United States has had 4.7 years of higher education. In an increasing number of the States a fifth year of training is required either before a person may begin to teach in secondary school or within a stated period of time thereafter.

Inservice training for teachers is highly developed in the U.S.S.R. The emphasis, facilities, and personnel relating to the inservice institutes' programs impressed us, and teachers are encouraged to upgrade and update their teaching periodically. This situation appears to aid considerably in the adoption of new methods and practices, which is now taking place on a massive scale.

Educational Research

The magnitude, scope, and energies characterizing Soviet research programs in education impressed us. While this work is more or less centrally directed by the Russian Academy of Pedagogical Sciences in Moscow, much work is going on both systematically according to plans and experimentally. The findings of the large and coordinated staffs in the various research institutes appear to influence considerably what goes on in the schools. In this regard, through current changes, Soviet schools are feeling the effect of educational research and most likely will continue to do so. Limitations imposed by central controls appear, how-

ever, to circumscribe research activities and to hinder development of regional solutions to meet regional needs.

Physical Plant

Buildings and material equipment that we observed seemed inferior in design and construction to standards in U.S. education. Soviet educators with whom we talked tended to put less emphasis on material facilities than on mastery of subject matter. However some of them admitted that more and better material equipment and facilities of higher quality could enable Soviet students to acquire better habits in performing practical work. In the schools we visited, visual aids were plentiful and often skillfully made.

Quality of Education

It is unwise to attempt to reach valid and definitive judgments on the quality of education on the basis of limited observations. In the schools and classes that we visited, indications were that, in the main, Soviet education is effective in teaching certain academic and technical subjects. The academic curriculum directs pupils to steadily rising conceptual maturities in mathematics and sciences at a fairly rapid pace. That has been the design and purpose of Soviet education, but as we know, that design is undergoing change in the U.S.S.R. The same pattern has applied to studies in the social science and humanities area.

In our view, there is no adequate testing system used in the Soviet schools to ascertain the real level of achievement reached by students. National requirements are indeed published annually for examining purposes, but the required content of these examinations varies little from year to year. Furthermore, questions in the sciences are made up from official problems manuals which are available to all schools and which provide pupils with the very material to be used in the examinations; local schools and districts make up their own questions in other subjects (in line with national norms), and these can vary significantly in difficulty and appropriateness; and we do not have any published information by Soviet authorities on the scores made by students on a national scale. All of these factors, and

others of a less tangible nature, prevent true evaluation of Soviet scholastic achievement.

In classes of polytechnic education, we found that the work done in workshops was not as high quality generally as that done in American school workshops. Similarly, the quality of the finished technical drawings that we saw could be improved, although there were exceptions. Furthermore, the scope of the technical drawing courses is narrower than in American schools; for example, architectural plans are not included in these classes. A number of workshops (wood- and metal-working) were poorly lighted, their benches and equipment seemed crowded and in need of space, and machines sometimes lacked safety guards.

Reforms

The most impressive aspect of Soviet schools today is their tremendous effort to reorganize their curriculums and methods. The focus of this effort is to introduce polytechnic-labor education along with the traditional academic program. In this way, Soviet educators aim to transform their schools into dual purpose institutions which can furnish youth the academic basis for higher education as well as a practical preparation for Soviet living. This new program is the first attempt to diversify Soviet secondary education since the reforms of 1931–32. The diversification appears to be limited in scope, concentrating on deepening youths' practical understanding and ability to apply theory, and on training them in a worker specialty in one of several main occupational sectors (industrial, agricultural, trade, transport, etc.) of the national economy. In general, it appears to us that Soviet leaders in education have also assigned themselves the task of building a solid basis for the general and technical upgrading of youth, not only of this generation but also of future generations.

Industrial and agricultural sciences and technical developments are now causing Soviet educators to think about future needs for readapting the schools to give more appropriate instruction for the incipient age of automation, atomic power, and space. We consider the new Soviet program to be a dynamic move, and it seems to promise the crystallization of new philosophic concepts in education as well as the emergence of many practical and material problems. Soviet educators tell us that, on the whole, they are optimistic about the prospect for their important plans. It will be interesting, to say the least, to observe the coming

Soviet educational measures and their role in Soviet cultural development.

In the light of our own experience and our knowledge of American programs resembling polytechnic education, we are of the opinion that at the present time Soviet general schools require more time in practical arts work than do similar American schools generally. At the same time, the Soviet curriculum is narrower in scope than the American curriculum. We feel that differences in economic requirements and technical background in the two societies account in the main for this situation. The size, character, and future plans of the polytechnic program in the U.S.S.R. are such that we must consider it as an integral part of the Soviet philosophy of education. It is not a subject but in fact a *type* of education, and other subjects in the curriculum, such as physics, mathematics, chemistry, and biology, contribute to the polytechnic area. Geography and language training are also considered to be pertinent to the development of polytechnic education.

The new polytechnic curriculum, if fully implemented, will give the Soviet general school a technical-work experience program not before attempted by schools of a modern industrial nation on such a vast scale. The skills aspect of this program, begun in the school shop (or garden plot) and culminated in the factory (or on the farm), aims to provide pupils with a choice of specialty training, but this choice tends to be limited by the enterprise located near the school, with which the school officials arrange cooperative work programs. The shop work and cooperative work experience with industry and agriculture are so organized as to contribute to the national economy while teaching youths the applications of theory, general technical knowledge, and inculcating attitudes toward labor and laboring people. After the tenth grade, however, it seems to us that the work experience has more productive than educative significance. By that time, the student has chosen his work specialty, knows its basic requirements and techniques, and has acquired a certain proficiency. Apparently related to this situation is the Government's new requirement that first-time enrollees in schools of higher education have 2 years' work experience.

One important part of the reforms under way is the growing number of boarding schools. While our visits to this type of school were brief, it was clear to us that Soviet authorities are giving careful attention to this new school.

Our educational mission to the U.S.S.R. helped to deepen our understanding of Soviet education, already nourished by others'

previous visits and reports, and helped us to determine more precisely than before the actual performance of teacher and pupil. This understanding enables us to appreciate the fact that the schools in Russia and other Soviet republics have been striving, on an increasingly mass basis, to meet the *particular* needs of their type of society. These needs are determined mainly by industrial plans and by a centralized political system dedicated to a materialistic philosophy. We are encouraged by the fact that our Soviet visit reconfirmed our dedication to developing American educational institutions along the lines that they have historically taken and to stimulating that development still more through such experiences as this one.

What the end-results of the major Soviet reform in education will be is not for speculation here. We have attempted to describe some of the prominent aspects of that reform and the path designated by Soviet authorities for it to take. We sincerely hope that our efforts will be of service to American educators, and to interested educators everywhere.

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Appendixes

THE DOCUMENTARY MATERIALS that follow have been selected so as to give as complete a factual account as possible of the situation and developments in Soviet education, with special reference to our mission. An attempt is made to give the interested reader and student a body of reference materials in English, not otherwise available, which can be of assistance both in making studies and in following trends of general-polytechnic and teacher education in the U.S.S.R.

To accomplish fully this service, an even more complete documentation could be provided. Normal space considerations, however, require representative selections.

NOTE.—The curriculum tables that follow have been adapted from official study plans (*Uchebnye plany*) published by the R.S.F.S.R. Ministry of Education and the U.S.S.R. Ministry of Higher and Special Secondary Education. Curriculums for pedagogical institutes are taken from, *Uchebnye plany pedagogicheskikh institutov* (1957).

In each of the curriculums reproduced here, the following symbols have been used consistently:

"R" after the number of hours per week in a semester column and separated by a diagonal (/) indicates a *report* required in that semester; for example, 3/R. This report is an oral test taken by the student in the presence of the instructor in charge.

"E", similarly placed, indicates an *examination* required in that semester.

"P", similarly placed, indicates a special *project* required in that semester.

"LR", similarly placed, indicates a *laboratory report* due in that semester.

APPENDIX I
Curriculums for Schools of General Education R.S.F.S.R.

Table A. — Curriculum for 10-year school (1955-56)

Subjects	Number of hours a week in each grade [1]										Total hours	
	1	2	3	4	5	6	7	8	9	10	By the week	By the year
1	2	3	4	5	6	7	8	9	10	11	12	13
1. Russian language and literature [2]	13	13	13	9	9	8	6	6/5	4	4	84.5	2,788
2. Mathematics	6	6	6	6	6	6	6	6	6	6	60	1,980
3. History	----	----	----	2	2	2	2	4	4	4	20	660
4. Constitution of the U.S.S.R.	----	----	----	----	----	----	----	----	----	[3] 1	1	33
5. Geography	----	----	----	2	3	2	2	2/3	3	----	14.5	479
6. Biology	----	----	----	2	2	2	3	2	1	----	12	396
7. Physics	----	----	----	----	----	2	3	3	4	5/4	16.5	544
8. Astronomy	----	----	----	----	----	----	----	----	----	1	1	33
9. Chemistry	----	----	----	----	----	----	2	2	3	3/4	10.5	347
10. Psychology	----	----	----	----	----	----	----	----	----	1	1	33
11. Foreign language	----	----	----	----	4	4	3	3	3	3	20	660
12. Physical education	2	2	2	2	2	2	2	2	2	2	20	660
13. Drawing	1	1	1	1	1	1	----	----	----	----	6	198
14. Technical drawing	----	----	----	----	----	----	1	1	1	1	4	132
15. Singing	1	1	1	1	1	1	----	----	----	----	6	198
16. Work and practical exercises	1	1	1	1	2	2	2	----	----	----	10	330
17. Practice in agriculture with agricultural machinery and in electrotechnology	----	----	----	----	----	----	----	2	2	2	6	198
18. Excursions	----	----	----	----	----	----	----	----	----	----	----	188
Total	24	24	24	26	32	32	32	33	33	33	293	9,857

[1] In grades 1, 2, 3, and 10, the school year is 33 weeks; in grades 4–9, 34 weeks. Six school days in each year are devoted to excursions.

[2] From the general number of hours, given over in grades 1–3 to the Russian language, 2 hours a week are allotted for teaching penmanship in grade 1, and 1 hour a week in grades 2 and 3.

[3] The course in the Constitution of the U.S.S.R. was not taught in the 1957–58 school year to grade 10, since the students in grade 10 had already had the course in grade 7; in this way 1 hour a week in grade 10 was released in the 1957–58 school year for the improvement of the knowledge of those studying in the Russian language or other courses—at the discretion of the pedagogical council of the school.

SOURCE.—E. N. Medynskii. *Prosveshchenie v SSSR. (Education in the U.S.S.R.)* Moscow, 1955, p. 84.

Table B.—Curriculum for 10-year schools, to be implemented by 25 percent of the schools during school year 1957-58, and by 50 percent during 1958-59

Subjects	Number of hours a week in each grade [1] [Two figures for one grade in a column indicate number of hours for each semester]										Total hours		In addition to yearly hours in schools		Total year's hours in schools	
	1	2	3	4	5	6	7	8	9	10 [2]	By the week	By the year	Urban	Rural	Urban	Rural
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Russian language and literature [3]	13	13	13	9	9	8	6	5	4	4	84	2,856	----	----	2,856	2,856
2. Mathematics	6	6	6	6	6	6	6	6	6	6/5	59.5	2,023	----	----	2,023	2,023
3. History	----	----	----	2	2	2	2	4/3	3/4	4/5	19.5	663	----	----	663	663
4. Geography	----	----	----	2	3	2	2	2/3	3	----	14.5	493	----	----	493	493
5. Biology	----	----	----	2	2	2	3	2	1	----	12	408	----	----	408	408
6. Physics	----	----	----	----	----	2	3	3	4/3	4	15.5	527	----	----	527	527
7. Astronomy	----	----	----	----	----	----	----	----	----	1	1	34	----	----	34	34
8. Chemistry	----	----	----	----	----	----	2	2	2	4	10	340	----	----	340	340
9. Foreign language	----	----	----	----	4	4	3	3	3	3	20	680	----	----	680	680
10. Physical culture	2	2	2	2	2	2	2	3	3	3	23	782	----	----	782	782
11. Drawing	1	1	1	1	1	1	----	----	----	----	6	204	----	----	204	204
12. Technical drawing	----	----	----	----	----	----	1	1	1	1	4	136	----	----	136	136
13. Singing	1	1	1	1	1	1	----	----	----	----	6	204	----	----	204	204
14. Work (classes 1–4) and practical exercises in school workshops (classes 5–7)	1	1	2	2	2	2	2	----	----	----	12	408	----	----	408	408
Autumn and spring work in the school's practice area in classes 5–7 and educationally productive practice upon the termination of the school exercises in classes 5–6 [4]	----	----	----	----	----	----	----	----	----	----	----	----	102	138	102	138
15. Fundamentals of production	----	----	----	----	----	----	----	3	4	4	11	374	----	----	374	374
Educationally productive practice upon the termination of school exercises in classes 8–9 [5]	----	----	----	----	----	----	----	----	----	----	----	----	192	192	192	192
Excursions	----	----	----	----	----	----	----	----	----	----	----	----	191	191	191	191
Total	24	24	25	27	32	32	32	34	34	34	298	10,132	485	521	10,617	10,653
Optional (at the choice of those learning) practical courses	----	----	----	----	----	----	----	1	2	2	5	170	----	----	170	170

[1] In grades 1, 2, 3, and 10 the number of school weeks in the year is 34, and in grades 4 through 9, 35; of the total in grades 4 through 9, 1 week—6 school days in the year—is allotted to making excursions.

[2] The course on the Constitution of the U.S.S.R. usually required in grade 10 was not conducted in 1957–58 since students in this school year in grade 10

(CONTINUED ON NEXT PAGE)

Table C.—Experimental curriculum for grades 9, 10, and 11 of urban schools (1957-58)[1]

Subjects	Number of hours a week in each grade			Total hours	
	9	10	11	By the week	By the year
1	2	3	4	5	6
1. Literature	2	3	3	8	297
2. Mathematics	4	4	4	12	448
3. History	3	4	3	10	875
4. U.S.S.R. Constitution			1	1	34
5. Economic geography	3			3	117
6. Physics	4	3	2	9	341
7. Astronomy		2/0		1	39
8. Chemistry	2	3	2	7	263
9. Biology	1			1	39
10. Foreign language	3	3	2	8	302
11. Technical drawing	2			2	78
12. Physical education	2	2	1	5	190
13. Principles of industrial production	2	0/2		3	117
Total	28	24	18	70	2,640
14. Production (theoretical and practical) training and production work	6	12	18	36	1,314
Total	34	36	36	106	3,954
Extracurricular activities (sport, various types of art, etc.)	3	3	3	9	336

NOTE.—(1) Academic year in grades 9–10 is 39 weeks, and in grade 11 is 34 weeks. (2) From the total number of hours which are provided in production training and production work, for theoretical study there are allocated 2 hours per week in grade 9, 4 hours in grade 10, and 2 hours in grade 11.

SOURCE.—S. G. Shapovalenko, *ed. Soedinenie obucheniia s proizvoditel'nym trudom uchashchikhsia.* (Combining instruction with production work of pupils. An experience of fifty schools in the R.S.F.S.R.) Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1958. P. 198.

FOOTNOTES FOR TABLE B

(Continued from Page 219)

had already had the course in grade 7. Therefore, from the 5 hours a week, devoted in the second half year in grade 10 to the history of the U.S.S.R., 1 hour was used at the discretion of the director of the school.

[3] Out of the total hours devoted to the Russian language, 2 hours per week is allocated to penmanship in grade 1, and in grades 2 and 3, 1 hour a week is usually required.

[4] In grades 5, 6, and 7, 22 hours a week is allotted in each for fall and spring work at the school practice area.

[5] In addition to practical exercises and educationally productive practice, conducted in grades 5–7 and 8-10 during the school year, there is provided for:

a. Educationally productive practice in urban schools—at the school's practice area—at the transition from grade 5 to 6—6 working days, and from grades 6 to 7—6 working days, at the rate of 3 hours a day; in the rural schools, the school's plot on a collective farm, on the transition from grade 5 to 7—12 working days at the rate of 3 hours a day.

b. Educationally productive practice in agriculture upon the transition from grade 8 to 9 for pupils in the urban and rural schools for 24 working days at 4 hours a day.

c. At the transition from grade 9 to 10, educational productive practice in agriculture for pupils in rural schools—24 working days, and in industrial establishments for pupils in urban schools for 24 working days at 4 hours a day.

SOURCE.—U. S. Department of Health, Education, and Welfare, Office of Education. *Soviet Commitment to Education.* (Bulletin 1959, No. 16.) Report of the First Official U. S. Education Mission to the U.S.S.R. Washington, U. S. Government Printing Office, 1959, pp. 40–41.

NOTE.—For teaching pupils in grade 10 practical driving of a motor car (tractor) there is devoted 10 school hours for each pupil.

Table D. — Experimental curriculum for grades 9, 10, and 11 of rural schools (1958-59)[1]

Subjects	Number of hours a week in each grade			Total hours	
	9	10	11	By the week	By the year
1	2	3	4	5	6
1. Literature	4	4	4	12	368
2. Mathematics	5	5	5	15	460
3. History	3	4	5	12	370
4. Constitution of the U.S.S.R. (Civics)			0/2	1	32
5. Economic geography	2	2		4	120
6. Physics	4	3	4	11	338
7. Astronomy			2/0	1	32
8. Chemistry	2	3	3	8	246
9. Biology	2			2	60
10. Foreign language	3	3	3	9	276
11. Physical education	2	2	2	6	184
12. Technical drawing	1	2		3	90
Total	28	28	28	84	2,576
13. Principles of agricultural production, and production training (theoretical and practical)	8	8	8	24	736
Total	36	36	36	108	3,312
14. Productive labor (6 hours per day)	54 days	54 days	18 days	126 days	756
Extracurricula activities: (sport, various types of art, etc.)	3	3	3	9	276

[1] This curriculum was tried out in a number of different schools.

NOTE.—Academic year in grades 9–10 is 30 weeks, and in grade 11 is 32 weeks.

SOURCE.—S. G. Shapovalenko, *ed.*, *op. cit.*, p. 201.

APPENDIX II

Curriculums for Labor-Polytechnic Schools of General Education

Table E.—Study plan for 8-year school

Subjects	Number of hours a week in each grade								Total hours	
	1	2	3	4	5	6	7	8	By the week	By the year
1	2	3	4	5	6	7	8	9	10	11
1. Russian language	12	12	12	10	6	5	3	2	62	2,184
2. Literature	----	----	----	----	2	3	2	3	10	357
3. Mathematics	6	6	6	6	6	6	6	5	47	1,663
4. History. Constitution of U.S.S.R.	----	----	----	2	2	2	2	3	11	391
5. Nature study	----	----	----	3	----	----	----	----	3	105
6. Geography	----	----	----	----	2	2	2	2	8	286
7. Biology	----	----	----	----	2	2	2	2	8	286
8. Physics	----	----	----	----	----	2	2	3	7	249
9. Chemistry	----	----	----	----	----	----	2	2	4	142
10. Technical drawing	----	----	----	----	----	----	1	1	2	71
11. Foreign language	----	----	----	----	4	3	3	3	13	465
Total	18	18	18	21	24	25	25	26	175	6,199
12. Drawing	1	1	1	1	1	1	1	----	7	248
13. Music and singing	1	1	1	1	1	1	1	1	8	283
14. Physical education	2	2	2	2	2	2	2	2	16	566
Total	4	4	4	4	4	4	4	3	31	1,097
15. Labor instruction	2	2	2	2	3	3	3	3	20	709
16. Socially-useful work	----	----	2	2	2	2	2	2	12	426
17. Socially-productive practice in grades 5–8, 2 weeks each year at the end of the school year.[1]	----	----	----	----	----	----	----	----	----	180
Total	2	2	4	4	5	5	5	5	32	1,315
Grand Total	24	24	26	29	33	34	34	34	238	8,611

[1] Examples of practice are: Tending public parks, raising poultry and rabbits at collective farms, performing simple shop operations in industry, etc. See E. Afanasenko, "The Soviet School System Reorganized," in *USSR*, No. 10 (37), 1959, Washington, Embassy of the U.S.S.R. in the U.S.A. P. 47.

NOTE.—The school year will begin on September 1, and terminate 1) for grades 1 to 4, on May 31; 2) for grades 5 to 7, on June 19; and 3) for grade 8, on June 25 (including examination period).

The year is divided into 4 quarters; a vacation period follows each quarter as follows: November 5–9 (5 days); December 30-January 10 (12 days); March 24-31 (8 days); and summer vacation after school closes.

The length of the school year for the various grades is as follows: Grades 1 to 4, 35 weeks; grades 5 to 7, 38 weeks (including 2 weeks for socially-productive practices); and grade 8, 39 weeks (including 2 weeks for socially-productive practice and 2 weeks for preparing for and taking the final examinations).

SOURCES.—*Uchitel'skaia gazeta*, August 29, 1959; and *Narodnoe obrazovanie*, No. 11 (November), 1959, pp. 9 ff.

Table F.—Study plan for urban secondary school with production training (planned after 1963)

Subjects	Number of hours a week in each grade			Total hours	
	9	10	11	By the week	By the year
1	2	3	4	5	6
1. Literature	3	3	3	9	339
2. Mathematics	4	4	4	12	452
3. History	2	3	4	9	335
4. Constitution of U.S.S.R.			2	2	70
5. Economic geography		2	2	4	148
6. Physics	4	4	2	10	382
7. Astronomy		1		1	39
8. Chemistry	2	3	2	7	265
9. Biology	3			3	117
10. Technical drawing	2			2	78
11. Foreign language	2	2	3	7	261
12. Physical education	2	2	2	6	226
Total	24	24	24	72	2,712
13. General technical subjects, production (theoretical and practical) instruction, and productive labor	12	12	12	36	1,356
Grand Total	36	36	36	108	4,068
14. Optional activities [1]	2	2	2	6	226

[1] Indications of kinds of optional activities offered are not available to us.

NOTE.—The school year will begin on September 1 and end on June 25 (including 4 weeks for preparing and taking final examinations. The year is divided into two parts, from September 1 to December 29, and from January 11 to the end of the school year. Each grade will have a school year of 39 weeks.

SOURCES.—Same as cited in footnote to table E.

Table G.—Study plan for rural secondary school with production training (planned after 1963)

Subjects	Number of hours a week in each grade			Total hours	
	9	10	11	By the week	By the year
1	2	3	4	5	6
1. Literature	4	3	4	11	338
2. Mathematics	5	4/5	5	14.5	445
3. History	3	4	4	11	338
4. Constitution of U.S.S.R.	-------	-------	2	2	64
5. Economic geography	-------	3/2	2/3	5	155
6. Physics	5	5	3/2	12.5	380
7. Astronomy	-------	1	-------	1	30
8. Chemistry	2/3	3	3	8.5	261
9. Biology	4	-------	-------	4	120
10. Technical drawing	3/2	-------	-------	2.5	75
11. Foreign language	3	3	3	9	276
12. Physical education	2	2	3	7	216
Total	31	28	29	88	2,698
13. Fundamentals of agricultural production and production (theoretical and practical) instruction	5	8	7	20	614
Total	36	36	36	108	3,312
14. Productive labor according to seasons:					
days	(54)	(54)	(18)	----------	(126)
hours	324	324	108	----------	756
Grand Total	-------	-------	-------	----------	4,068
15. Optional activities [1]	2	2	2	6	184

[1] No indication of the specific kinds of optional activities to be offered is now available.

NOTE.—See remarks under *Note* in table F.

SOURCE.—*Narodnoe obrazovanie.* (Public Education), No. 11 (November), 1959, pp. 12–13.

Table H. — Study plan for evening (shift, seasonal) secondary general educational school (planned after 1963)

Subjects	Number of hours a week in each grade			Total hours by the week
	9	10	11	
1	2	3	4	5
1. Literature	2	2	2	6
2. Mathematics	3	3	3	9
3. History	1	2/1	2	4.5
4. Constitution of U.S.S.R.	-------	-------	1	1
5. Economic geography	-------	2/1	1/2	3
6. Physics	3	3	2	8
7. Astronomy	-------	0/1	-------	0.5
8. Chemistry	1/2	2	2/1	5
9. Biology	2/1	-------	-------	1.5
10. Technical drawing	1/2	-------	-------	1.5
11. Foreign language	2/1	1/2	2	5
Total	15	15	15	45
12. Optional activities for raising pupils' vocational qualifications	2	2	2	6
13. Consultations	3	3	3	9
Grand Total	20	20	20	60

NOTE.—For evening shift schools, the school year will be 36 weeks; and for evening seasonal schools, 26 weeks. In the eleventh grade of the evening shift school, 3 weeks are to be taken for final examinations.

The school year starts on September 1 for evening shift schools, and it is divided into two parts, with a vacation of 10 days (January 1–10) separating them.

Correspondence lessons are to be organized for those persons who cannot for various reasons follow the regularly established program.

SOURCE.—*Narodnoe obrazovanie* (Public Education), No. 11 (November), 1959, pp. 11, 13.

APPENDIX III

Experimental Schools In R.S.F.S.R. (1957-58)

Table I. — Urban schools

Number and location of school	Number of pupils in experimental classes	Number of specialties offered	Number and location of school	Number of pupils in experimental classes	Number of specialties offered
1	2	3	4	5	6
1. 475 Moscow	65	15	21. 22 Rostov-on-Don	58	13
2. 381 Moscow	64	6	22. 28 Taganrog	63	4
3. 204 Moscow	46	14	23. 55 Ivanovo	58	5
4. 607 Moscow	46	7	24. 1 Stalingrad	41	3
5. 287 Moscow	52	10	25. 4 Stalingrad	45	3
6. 503 Moscow	55	10	26. 6 Nevinnomysk	66	13
7. 16 Moscow	45	3	27. 47 Krasnodar	125	9
8. 529 Moscow	28	13	28. 17 Sverdlovsk	52	4
9. 441 Moscow	55	8	29. 27 Sverdlovsk	57	7
10. 155 Moscow	52	7	30. 10 Novosibirsk	48	11
11. 3 Orekhovo-Zuevo (Moscow Oblast')	53	5	31. 47 Novosibirsk	51	9
12. 38 Leningrad	62	8	32. 99 Novosibirsk	44	11
13. 118 Leningrad	58	12	33. 17 Cheliabinsk	55	8
14. 139 Leningrad	52	12	34. 91 Cheliabinsk	57	8
15. 366 Leningrad	53	11	35. 2 Morshansk	59	5
16. 4 Leningrad	41	8	36. 10 Ufa	65	7
20. 4 Gatchina (Leningrad			37. 9 Nizhnii Tagil	60	2
17. Oblast')	55	7	38. 26 Kazan'	------	------
18. 133 Gor'kii	111	9	39. 53 Krasnodar	------	------
19. 13 Dzerzhinsk	57	7	40. 281 Leningrad	------	------
22 Tula	50	16	41. 20 Rostov-on-Don	------	------
			42. 20 Kamensk-Ural'sk	------	------

SOURCE.—S. G. Shapovalenko, *ed.*, *op. cit.*, p. 203. The reader is advised that this list of experimental school is by no means exhaustive. We have evidence that a number of other schools in the Russian Federation, not to mention other Soviet Republics, have significant experimental programs.

Table J. — Rural schools

Name of School	*Location of School*
1. Starominskii Secondary, No. 8	Krasnodar Krai, R.S.F.S.R.
2. Elizavetenskii Secondary	Leningrad Oblast', R.S.F.S.R.
3. Siverskii Secondary	Leningrad Oblast', R.S.F.S.R.
4. School in Memory of Lenin	Moscow Oblast', R.S.F.S.R.
5. Erminshinskii Secondary	Riazan' Oblast', R.S.F.S.R.
6. Pokrovskii Secondary	Rostov Oblast', R.S.F.S.R.
7. Olginskii Secondary	Stavropolskii Krai, R.S.F.S.R.

APPENDIX IV

Course Outline for Polytechnic Instruction (Grades 8 through 10)

Fundamentals of production (grades 8 through 10 in urban schools)

Program	Class hours	Excursions	Practical work	Total hours
1	2	3	4	5
I. Machine Study (Grade 8) [1]	40	6	56	102
A. Introduction	2	0	0	2
B. Elements of the Technology of Metals:				
Topic 1. Machine-Building Materials	4	2	0	6
Topic 2. Processing of Metals by Cutting	6	0	[2] 12	18
Topic 3. Assembly and Finishing of Items	4	0	12	16
C. Basic Information about the Mechanisms and Machines:				
Topic 1. Parts of Machines and Their Junctures	4	0	[3] 4	8
Topic 2. Construction and Work of the Mechanisms	14	0	14	28
Topic 3. Construction and Work of Machines	6	4	14	24
II. Fundamentals of Industrial Production in the Form of a Specific Enterprise (Grade 9)	30–50	0	202–182	[4] 232
A. General Acquaintance with Industrial Enterprise (Study of production branch, production of enterprise, raw materials of enterprise and auxiliary materials, technology and techniques of production, and supply of power and water for enterprise).	30–50	0	0	30–50
B. Industrial Practice:				
1. During study year	0	0	106–86	106–86
2. During summer period (Work in main shops, auxiliary shops, and plant laboratory and on testing finished products, and individual tasks at workbenches.)	0	0	96	96
III. Automobiles (Grade 10) [5]	40	0	38	78
A. Introduction	2	0	0	2
Topic 1. Automobile Engine	4	0	0	4
Topic 2. Crankgear and Gas-Distributing Mechanisms	2	0	6	8
Topic 3. Cooling System	2	0	2	4
Topic 4. System of Oiling Engine	2	0	2	4
Topic 5. Feeding of Engine	4	0	4	8
Topic 6. Ignition System	2	0	2	4
Topic 7. Power Transmission of Automobile	4	0	6	10
Topic 8. Running Part of Automobile	2	0	2	4
Topic 9. Steering Mechanism	4	0	4	8
Topic 10. Electrical Equipment of Automobile	4	0	2	6
Topic 11. Principles of Driving of Automobile and Technical Servicing	4	0	0	4
Topic 12. Manufacture and Repair of Automobiles	2	0	0	2
B. Automobile driving				
(a) Preliminary Acquaintance	2	0	0	2
(b) Exercise in Driving Automobile	0	0	8	8
IV. Electrotechnics (Grade 10) [6]	36	0	32	68
A. Introduction	2	0	0	2
B. Basic Electro-Technical Materials	4	0	0	4
C. Technical Electric Measuring Instruments	6	0	8	14
D. Electrical Machines				
1. Basic Information about Magnetic Materials and Understanding of Magnetic Chain	2	0	0	2
2. Single-Phase and Three- Phase Currents	10	0	8	18
3. Direct Current Machine and Semiconductor Rectifiers	4	0	8	12
E. Production and Utilization of Electric Power	8	0	8	16
V. Summer Agricultural Practice for Students of Urban Schools (24 days when passing from grade 8 to 9).				

See footnotes at end of appendix IV.

Fundamentals of agricultural production (grades 8 to 10 in rural schools)[7]

Program	Class hours	Excursions	Practical work hours	Total hours
1	2	3	4	5
I. Fundamentals of Plant Growing (Grade 8)	29	4	35	68
A. Introduction	1	0	0	1
B. Conditions of Growth and Development of Plants	2	0	3	5
C. The Soil, Its agronomic Properties and the Role of Mineral Feeding of Plants	4	2	2	8
D. Working of Soil	3	2	0	5
E. Fertilizers	4	0	4	8
F. The Principal Field Crops and Agrotechnical Bases for Rotation Crops	2	0	4	6
G. Determining the Quality of the Sowing and Planting Material and Its Processing Prior to Sowing	2	0	2	4
H. The Sowing and Planting of the Principal Field Crops	4	0	[8] 10	14
I. Care of the Principal Field Crops and the Harvest	4	0	[8] 6	10
J. Organization of Production and Labor in a Kolkhoz, or Sovkhoz [8]	3	0	4	7
K. Summer Training-Production Practice Between Grades 8 and 9: First Period: Care of Crops (12 days). Second Period (during Harvest): Harvesting and the Sowing of Winter Crops (12 days).				
II. Agricultural Machinery	32	0	38	70
A. Grade 8	12	0	22	34
1. Introduction	1	0	0	1
2. Basic Information about Machine Parts and Mechanisms	2	0	6	8
3. Plows	2	0	4	6
4. Harrows and Cultivators	2	0	4	6
5. Grain-Cleaning Machines	1	0	2	3
6. Sowing Machine (Drills)	4	0	6	10
B. Grade 9 (Study of (a) grain combines, (b) potato- harvesting combines, (c) flax-harvesting combines, and (e) corn-harvesting combines.)	20	0	16	36
III. Fundamentals of Animal Husbandry (Grade 9)	22	5	41	68
A. Introduction	1	3	0	4
B. Physical Build of Horned Cattle and Its Type of Productivity (Meat, Milk or Both)	1	0	3	4
C. The Keeping of Agricultural Animals and Their Care	4	2	6	12
D. Feed and Feed Base for Agricultural Animals	4	0	6	10
E. The Feeding and Fattening of Animals. Mechanization of Feed Preparation	4	0	10	14
F. The Milking of Cows and Calculation of Yield	4	0	6	10
G. The Breeding of Animals and the Raising of Young Stock	4	0	4	8
H. Work on Kolkhoz or Sovkhoz Dairy	0	0	6	6
I. Summer Training-Production Practice in Passing from Grade 9 to 10: Care of Crops: 12 days upon completion of studies. Gathering of Harvest: 12 days during harvesting.				

Program	Class hours	Excursions	Practical work hours	Total hours
IV. Agricultural Machinery	55	2	43	100
A. Grade 9	20	2	10	32
1. Introduction	1	0	0	1
2. Classification and General Construction of Tractors	2	0	0	2
3. Classification and General Construction of Tractor Engines	2	0	0	2
4. The Principle of the Work of Tractor Engines	2	2	0	4
5. Mechanisms and Systems of Tractor Engines Crankgear Mechanism	2	0	0	2
6. Distribution Mechanism	2	0	2	4
7. Fuel System	6	0	6	12
8. Cooling System	3	0	2	5
B. Grade 10	35		33	68
1. Lubricating System	2	0	4	6
2. Starter Arrangement on Diesel Engines	2	0	2	4
3. Electrical Equipment of Tractor	7	0	4	11
4. Transmission of Tractors:				
a. Coupling Clutch and Intermediate Connection of Coupling Clutch with Transmission Box	2	0	2	4
b. Transmission Box	2	0	2	4
c. Rear Bridge and Steering Mechanism of Tractor	6	0	0	6
5. Framework and Running Part of Tractor. Arrangement for Additional Utilization of Power of Tractor Engine:				
a. Framework and Running Part of Tractor	4	0	0	4
b. Arrangement for Additional Utilization of Power of Tractor Engine	4	0	6	10
6. Driving of Tractor:				
a. Safety Techniques while Working with Tractor	4	0	0	4
b. Rules for Driving Tractor	2	0	13	15

[1] Ministry of Education of RSFSR, *Programmy srednei shkoly na 1958/59 uchebnyi god (Programs for Secondary School for Academic Year 1958–1959)*, Moscow, 1958, p. 54–74.

[2] Practical work for processing of metals by cutting is done on a lathe (turning) or milling machine.

[3] Practical work on parts of machines and their junctures consists of making bolts, screws, nuts, etc.

[4] See topical outline in text for a machine building plant, p. 122.

[5] Ministry of Education of RSFSR, *op. cit.*, p. 150–159.

[6] *Ibid.*, p. 159–167 (Electrotechnics is also taught in rural schools, second semester, grade 10).

[7] *Ibid.*, p. 169–203.

[8] Practical work is performed on a *kolkhoz* (collective farm) and *sovkhoz* (State farm).

APPENDIX V

Study Plan for Training Turners[1]

Showing the hours per week devoted to each class during the four years of training in special vocational schools

FIRST YEAR

Classes	First quarter (9 weeks)	Second quarter [2] (8 weeks)	Third quarter (13 weeks)	Fourth quarter [3]		Total hours
				10 weeks	3 weeks	
1	2	3	4	5	6	7
I. General studies cycle:						
1. Georgian language for the Georgian group	3	3	3	3	------	121
2. Georgian language for the Russian group	2	2	1	1	------	55
3. Russian language and literature for the Georgian group	3	3	3	3	------	121
4. Russian language and literature for the Russian group	4	4	4	4	------	160
5. Mathematics	4	4	4	4	------	160
6. History	2	2	2	2	------	80
7. Geography	2	2	2	2	------	80
8. Biology	2	2	2	2	------	80
9. Physics	------	------	------	------	------	------
10. Chemistry	------	------	------	------	------	------
11. Foreign language	2	2	2	2	------	80
12. Political education	------	------	------	------	------	------
II. Production and technological cycle:						
1. Production training	12	12	12	12	24	[4] 544
2. Special technology	2	2	2	2	------	[4] 88
3. General technology of metals	2	2	2	2	------	80
4. Mechanical drawing	2	2	2	2	------	80
5. Principles of mechanics	------	------	------	------	------	------
6. Principles of electrical technics	------	------	------	------	------	------
7. Economics and production organization	------	------	------	------	------	------
III. Physical education	2	2	2	2	------	80

See footnotes at end of table.

SECOND YEAR

Classes	First quarter (9 weeks)	Second quarter [2] (8 weeks)	Third quarter (13 weeks)	Fourth quarter [3]		Total hours
				10 weeks	3 weeks	
1	2	3	4	5	6	7
I. General studies cycle:						
1. Georgian language for the Georgian group	3	3	3	3	------	121
2. Georgian language for the Russian group	2	2	1	1	------	55
3. Russian language and literature for the Georgian group	3	3	3	3	------	121
4. Russian language and literature for the Russian group	3	3	4	4	------	143
5. Mathematics	3	3	4	4	------	143
6. History	2	2	1	1	------	57
7. Geography	2	2	1	1	------	57
8. Biology	2	2	2	2	------	80
9. Physics	2	2	2	2	------	80
10. Chemistry	------	------	------	------	------	------
11. Foreign language	2	2	2	2	------	80
12. Political education	------	------	------	------	------	------
II. Production and technological cycle:						
1. Production training	12	12	12	12	[5] 24	[5] 540
2. Special technology	2	2	2	2	------	80
3. General technology of metals	2	2	2	2	------	80
4. Mechanical drawing	2	2	2	2	------	80
5. Principles of mechanics	------	------	------	------	------	------
6. Principles of electrical technics	------	------	------	------	------	------
7. Economics and production organization	------	------	------	------	------	------
III. Physical education	2	2	2	2	------	80

See footnotes at end of table.

THIRD YEAR

Classes	First quarter (9 weeks)	Second quarter [2] (8 weeks)	Third quarter (13 weeks)	Fourth quarter [6]		Total hours
				8 weeks	2 weeks	
1	2	3	4	5	6	7
I. General studies cycle:						
1. Georgian language for the Georgian group	3	3	3	3	------	121
2. Georgian language for the Russian group	2	2	1	1	------	55
3. Russian language and literature for the Georgian group	3	3	3	3	------	121
4. Russian language and literature for the Russian group	5	5	4	3	------	161
5. Mathematics	4	4	5	6	------	181
6. History	------	------	------	------	------	------
7. Geography	------	------	------	------	------	------
8. Biology	------	------	------	------	------	------
9. Physics	2	2	2	2	------	76
10. Chemistry	2	2	2	2	------	76
11. Foreign language	2	2	2	2	------	76
12. Political education	2	2	2	2	------	76
II. Production and technological cycle:						
1. Production training	12	12	12	12	24	528
2. Special technology	2	2	2	2	------	76
3. General technology of metals	------	------	------	------	------	------
4. Mechanical drawing	1	1	1	1	------	38
5. Principles of mechanics	2	2	2	2	------	76
6. Principles of electrical technics	------	------	------	------	------	------
7. Economics and production organization	------	------	------	------	------	------
III. Physical education	2	2	2	2	------	76

See footnotes at end of table.

FOURTH YEAR

Classes	First quarter (9 weeks)	Second quarter [2] (8 weeks)	Third quarter (11 weeks)	Fourth quarter [7]		Total hours for the fourth year [8]	Total hours for all four years
				13 weeks	1 week		
1	2	3	4	5	6	7	8
I. General studies cycle·							
1. Georgian language for the Georgian group	------	------	------	------	------	------	464
2. Georgian language for the Russian group	------	------	------	------	------	------	484
3. Russian language and literature for the Georgian group	------	------	------	------	------	------	137
4. Russian language and literature for the Russian group	------	------	------	------	------	------	137
5. Mathematics	------	------	------	------	------	------	160
6. History	------	------	------	------	------	------	156
7. Geography	------	------	------	------	------	------	76
8. Biology	------	------	------	------	------	------	236
9. Physics	2	2	2	------	------	56	132
II. Production and technological cycle:							
1. Production training	20	20	27	[9] 41	41	1,211	2,823
2. Special technology	5	4	2	[10] 2	------	125	369
3. General technology of metals	------	------	------	------	------	------	160
4. Mechanical drawing	------	------	------	------	------	------	198
5. Principles of mechanics	4	4	2	------	------	90	166
6. Principles of electrical technics	5	4	2	------	------	99	99
7. Economics and production organization	------	2	2	------	------	38	38
III. Physical education	2	2	2	------	------	56	292

[1] *Uchebnyi plan.* (Curriculum.) Approved by Main Administration of Labor Reserves attached to U.S.S.R. Council of Ministers (June 20, 1957). Curriculum used in Vocational School #5, Tbilisi, Georgian S.S.R.

[2] Followed by 1 week and 5 days of vacation.

[3] Followed by 6 weeks and 5 days of vacation.

[4] Study of the principle of personal hygiene and industrial sanitation has been transferred from production training to special technology.

[5] Three days are allocated for taking examinations in the course on the general technology of metals.

[6] The fourth quarter of the third year is followed by 2 weeks of examinations.

[7] Followed by 3 weeks of examinations and 6 weeks and 5 days of vacation.

[8] The total hours for the fourth year when calculated by multiplying the hours per week by the number of weeks, do not always coincide with the total given in column 7; nevertheless they are shown on the original Russian document given to us in Tbilisi.

[9] Students who have not reached 18 years of age in the last year of the study program will receive only 36 hours per week in production training.

[10] Two hours per day are devoted to consultation dealing with final performance work.

APPENDIX VI

Inventory of Equipment for School Workshops (Grades 5 through 7)[1]

I. *Machine Tool Equipment*

Name of Equipment, Instruments, and Devices	*Quantity*
Screw-cutting lathe with attachments	2
Drill (table mounted) with bits for drilling holes, diameter of 12 mm.	4
Woodturning lathe with attachments	2
Combined joiner machine with circular saw (disk)	1
Grinder	1
Wet grinder with mechanical power-driven motor	1

II. *The Equipment, Instruments, and Devices for Metal Work*

A. For General Use	
Checking (surface) plate—small	1
Marking gage for mechanic (height gage)	1
Micrometer (from 0 to 25 mm.)	2
Angle gage	1
Spiral drills, various types	120
Steel plates, 300 x 400 mm. (or anvil on table)	2
Vise with jaws, 120–240 mm.	1
Hand clamp vise	5
Hammer for mechanic, 500 g.	3
Sledge hammer, 1 kg.	1
Metal shears	1
Hand drill	1
Tap wrench	2
Die plate	2
Screw taps	20
Cutter die and thread chaser	40
Thread gage	2
Electric soldering iron	6
Simple soldering iron	2
Blowpipe torch	1
Various types of wrenches for nuts	20
Monkey wrenches	2
Files, various types	50
Needle files	100
Various cutter bits (face cutters, cutoff cutters, etc.)	30
Countersink reamers, various types	7
Broach bits, various types	10
Groove chisel	8
Combination cutting and twisting pliers	10
Mandrels and holder for riveting	15
Handles for tools	100
Brushes for cleaning files	5
B. For Individual Use	
Workbench (combination)	20
Steel plates for table	20
Vises for mechanics with 100 mm. jaws	20
Hammers for mechanics	20
Electric solders (hammer type)	20
Steel scale ruler 300 mm.	20
Sliding calipers	20
Compass marker	20
Outside calipers	20
Scriber (marking tool)	20
Center punch	20
Squares	20

[1] A. G. Dubov, *Prakticheskie zaniatiia v uchebnykh masterskikh (Practical Studies in the School Workshops)*, Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1957, p. 199–202.

Name of Equipment, Instruments, and Devices	*Quantity*
Chisels for metal	60
Hand hacksaw	20
Snippers for cutting metal by hand	20
Bastard and smoother files, various cross sections and sizes	100
Flat pliers	20
Round nose pliers	20
Cutting pliers	20
Screwdrivers	20
Wooden mallet for working with sheet metal	20
Drawing set	20

III. *Equipment, Instruments, and Devices for Work with Wood*

A. General Use	
Marking compass	10
Bevel square	4
Protractors	4
Pincers	10
Clamps (metal and wooden)	20
Frame saw, various types	6
Saw, rounding (keyhole)	2
Handsaw for joiners, wide and narrow	4
Coping saw	10
Tables for coping saw	10
Planes	2
Channel molding plane	2
Grooving plane	1
Wood chisels, various widths	15
Wood chisel semicircle (round nose)	10
Gouge, various	10
Bits and brace	3
Flat drills, various designs and sizes	30
Gimlet, various sizes	5
Awl for woodwork	20
Bastard files of various sizes and cross sections	20
Rasp, flat and semicircle	10
Scrapers	5
Light axe	3
Circular cutter, hand	2
Grinding stone	10
Honing stone for sharpening tools	10
Blades for coping saw	200
B. For Individual Use	
Workbenches (combination)	20
Folding meter (folding rule)	20
Steel rule for scaling 500 mm.	20
Marking squares	20
Surface gage (simple)	20
Light hammers for carpentry	20
Hacksaw blades with raker tooth	20
Flat chisels, 10 and 15 mm.	40
Butt chisels	20
Mallet	20
Rough plane	20
Planes	20
Smoothing planes	20
Screwdrivers	20
Glue pot, volume .5–1 liter	2
Handles for the tools	100

IV. *Various Equipment, Instruments, and Devices*

Saw blade clamps	1
Saw set	1
Device for sharpening plane iron, chisels	1
Electric plates	2
Glass cutter	1
Drawing set	1
The set of drawing instruments (drawing board, rule, squares, irregular curves)	1
Oiler (oil can)	2
Spatula	5
Brushes for glue	20
Brushes for various painting purposes	20

V. *Visual Aids, Charts, and Literature*

Name of Equipment, Instruments, and Devices	*Quantity*
Collection of samples of wood	1
Collection of samples of metals and alloys	1
Collection of samples which could be extracted from wood	1
Study chart on treatment of woodwork	1
Study chart on metalwork	1
Chart on safety engineering	1
Chart on individual types of joiner work, mechanic, and electric assembly work	1
Library pertaining to method and technology of joiner work, mechanics, electric and assembly work, and various types of reference material	1

VI. *Furniture and Inventory*

Table for teacher	2
Chair for teacher	2
Stools for students	40
Blackboard	2
Blackboard, movable	6
Lockers for keeping tools	2
Lockers for books	2
First-aid kit	2
Wastebasket	2
Brushes	20
Brushes for clothes	20
Towel (to be used only by the leaders)	5
Shop coat for leaders	2
Hanger for the shop coat	1
Brushes for the floor	6
Table for assembly work, chopping, etc.	2

APPENDIX VII

Inventory of Basic Materials Which are Necessary for Studying and for Working Outside of Class Assignments in the Shop[1]

(Quantity indicated according to calculation for work of six 5 to 7 grades during the academic year)

Name of Material	*Size*	*Quantity*
Pine boards (from 13 to 35 mm.), first grade	cu. m.	2.25
Pine boards already cut to thickness (from 40 to 50 mm.), first grade	"	2
Birch boards 25 mm., first grade	"	.5
Linden boards, thin, first and second grades	"	.5
Plywood birch 3-4 mm., first and second grades	"	.5
Glue for carpenters	kg.	4
Wire nails for construction from 10 to 50 mm.	"	20
Screws, semicircle and flat sinking heads (round and flat heads)	"	5
Sheet metal steel (also iron for roofing)	"	100
The black sheet metal, polished, Nos. 25, 28, and 50	"	20
Sheet metal wide, thickness .24 to .48 mm.	"	20
Round steel, diameter 10, 20, and 50 mm., manufacture ST–3	"	75
Strip steel 4 x 12 mm., manufacture ST–3	"	25
Galvanized sheet metal	"	50
Cold rolled steel strips .5 mm.	kg.	5
Steel wire, round, thickness .1–2 mm.	"	15
Aluminum sheet metal, thickness .5–3 mm.	"	40
Aluminum, round (rod type), diameter 3–10 mm.	"	20
Aluminum wire, thickness 2–3 mm.	"	3
Aluminum pipes from 10 x 8 to 25 x 20 mm.	"	10
Brass sheet metal, thickness .5–.8 mm.	"	4
Brass wire, thickness 1–2 mm.	"	3
Coiling copper wire, type PESHO and PEBO	"	3
Coiling copper wire, type PE or PEL	"	3
Copper wire for assemblying, naked (plain)	"	2
Cord for electric wiring, insulated with cotton fabric, type PR or PRO	meters, linear	120
Solder, tin-lead (type POS–60 or others)	kg.	3
Tin	"	2
Screws, diameter 3, 4, or 5 mm., various lengths, type M3–M4	"	4
Nuts, M3–M5	"	3
Washer with screws M3–M5	"	1
Glass, ordinary and colored, 2–5 mm.	"	10

[1] A. G. Dubov, *Prakticheskie zaniatiia v uchebnykh masterskikh (Practical Studies in the School Workshops)*, Moscow, R.S.F.S.R. Academy of Pedagogical Sciences, 1957, p. 203–204.

Ebonite sheets, thickness 3–4 mm.	"	5
Textolite sheet, thickness 2–4 mm.	"	5
Porcelain pulley	pieces	200
Porcelain tubes	"	50
Tape for insulation	kg.	1
Various types of electric fixtures, such as fuses, receptacles, light switches, cutting-in safeguard (circuit breaker), lamp socket, etc.	sets	50
Alcohol lac light	kg.	5
Oil lac light (No. 1, 2, 3, or 6)	"	2
Lacquer of various colors	"	3
Sealer	"	5
Enamel	"	3
Thinner	"	4
Turpentine	"	5
Sandpaper, Nos. 1 to 8	sq. meter	20
Emery paper (from No. 20 to No. 30)	linear meter	30

APPENDIX VIII

Curriculums for Pedagogical Institutes[1]

Table K. — Specialty: Russian language, literature, and history

Subjects	Hours per week by school year and by semester									Number of hours			
	1		2		3		4		5				
	1 (10 weeks)	2 (16 weeks)	3 (19 weeks)	4 (16 weeks)	5 (19 weeks)	6 (13 weeks)	7 (10 weeks)	8 (16 weeks)	9–10 (21 weeks)	Total	Lectures	Laboratory	Practical work or seminar
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. History of C.P.S.U.	3/R	4/E	3/R	4/E						224	120	104	
2. Political economy					2/R	3/E	2/R	3/E		140	98	42	
3. Dialectical and historical materialism							3/R	3/E	3/E	140	80	60	
4. Logic					4/E					70	44	26	
5. Psychology	2	3/E								84	50	34	
6. Pedagogy			3	4/R,E						120	70	50	
7. History of pedagogy					4/E					72	54	18	
8. School hygiene						1	-/R			36	18	18	
9. Foreign language	2/R	2/R	2/E	2/R	-/R	-/R	-/R	-/R		140		140	
10. Introduction to linguistics	3	2/E								80	54	26	
11. Russian language:													
a. Old-Slavonic	3/R	2/R								89	40	49	
b. Study of dialects		2/R								32	16	16	
c. Historical grammar			3/R	4/E						121	60	61	
d. Contemporary Russian			5/R	4/R	4/E	4/R	4/R	5/E		416	162	254	
e. History of literary Russian									2/E	42	22	20	
Total	3	4	8	8	4	4	4	5	2	700	300	400	
12. Introduction to the study of literature	3/E									60	40	20	

See footnotes at end of table.

For meaning of R and E symbols, see note on page 217.

Subjects	Hours per week by school year and by semester									Number of hours			
	1		2		3		4		5				
	1 (10 weeks)	2 (16 weeks)	3 (19 weeks)	4 (16 weeks)	5 (19 weeks)	6 (13 weeks)	7 (10 weeks)	8 (16 weeks)	9–10 (21 weeks)	Total	Lectures	Laboratory	Practical work or seminar
1	2	3	4	5	6	7	8	9	10	11	12	13	14
13. Russian literature.													
a. Spoken folk-literature	3/E									57	45	12	
b. Ancient Russian literature		3/R								48	36	12	
c. Literature of the 18th century			3/E							57	45	12	
d. Literature of the 19th century				4/R	3/R	4/E				173	113	60	
e. Literature of the 20th century							3/E			30	30		
f. Soviet literature								2	3/E	95	75	20	
Total	3	3	3	4	3	4	3	2	3	460	344	116	
14. Foreign literature:													
a. Ancient literature		2/R								32	32		
b. Literature of Renaissance, Middle Ages, and 17th century			2/E							38	38		
c. Literature of the 18th century				2/R						32	32		
d. Literature of the 19th century					2	3/E				82	82		
e. Literature of recent times						2	4/E			66	66		
Total		2	2	2	2	5	4			250	250		
15. History of the ancient world	5/R	4/E								160	106	54	
16. History of the Middle Ages			6/R	4/E						178	108	70	
17. History of Modern Times					5	5/E	4/R	4/E		264	174	90	
18. Modern history of the East									5/E	106	86	20	
19. History of the U.S.S.R.	5/R	4/E	5/R	4/E	4/R	3/E				430	290	140	
20. Methods of teaching Russian				2	2	2/R	3/E			100	52	48	
21. Methods of teaching literature						3/R	3/E			70	38	32	
22. Methods of teaching history					2/R	2/R				64	32	32	
23. Special courses (Russian language, literature, history)							2	3/E	3/E	130	130		
24. Special seminars (Russian language, literature, history)							2	4/R	4/R	168		168	
25. Special training	1	2/R								48		48	
26. Physical education	2/R	2/R	2/R	2/R						140		140	
Total hours	32	32	34	34	32	32	30	24	20	4,434	2,538	1,896	

Item	Number of exams, reports, and projects by semester								
	1		2		3		4		5
	1	2	3	4	5	6	7	8	9–10
1	2	3	4	5	6	7	8	9	10
Exams (37)	2	5	3	5	3	5	4	5	5
Reports (44)	6	7	6	6	5	5	6	2	1
Projects (4)	-------	-------	-------	1	-------	1	-------	1	1

TEACHER TRAINING (19 wks)

1. In Pioneer camps (3 wks in the 6th semester)
2. In schools (8 wks in the 7th semester and 8 wks in the 9th and 10th semesters)

Optional courses (fakul'tativnye distsipliny)

1. Practical training in conducting extracurricular and out-of-school activities (100 hrs.)
2. Latin language (68 hrs.)
3. A modern Slavonic language (CO hrs.)
4. Literature of the People's Democracies (60 hrs.)
5. Museum science (40 hrs.)
6. History of culture (60 hrs.)
7. Practical training in expressive reading (60 hrs.)
8. Practical training in construction of visual aids (40 hrs.)
9. Improving sports skills (420 hrs.)
10. Foreign language (in years 3 and 4, 140 hrs.)
11. Music and singing (250 hrs.)
12. Individual instruction in playing musical instruments (250 hrs.)

[1] *Uchebnye plany pedagogicheskikh institutov. (Curriculums for pedagogical institutes.)* Moscow, 1957, 31 p.

For meaning of R and E symbols, see note on page 217.

Table L.—Specialty: Russian language, literature, foreign language

Subjects	Hours per week by school year and by semester									Number of hours			
	1		2		3		4		5				
	1 (19 weeks)	2 (16 weeks)	3 (19 weeks)	4 (16 weeks)	5 (19 weeks)	6 (13 weeks)	7 (10 weeks)	8 (16 weeks)	9–10 (21 weeks)	Total	Lectures	Laboratory	Practical work or seminar
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. History of C.P.S.U.	3/R	4/E	3/R	4/E						224	120	104	
2. Political economy					2/R	3/E	2/R	3/E		140	98	42	
3. Dialectical and historical materialism							3/R	3/E	3/E	140	80	60	
4. Psychology	2	3/E								84	50	34	
5. Pedagogy			3	4/RE						120	70	50	
6. History of pedagogy					4/E					72	54	18	
7. School hygiene						2	-/R			36	18	18	
8. Introduction to linguistics	3	2/E								80	54	26	
9. Russian language:													
a. Old Slavonic	2/R	2/E								89	40	49	
b. Study of dialects		2/R								32	16	16	
c. Historical grammar			3/R	4/E						121	60	61	
d. Contemporary Russian			5/R	4/E	4/R	4/E	4/R	5/E		416	162	254	
e. History of literary Russian									2/E	42	22	20	
Total	3	4	8	8	4	4	4	5	2	700	300	400	
10. Introduction to the study of literature	3/E									60	40	20	

11. Russian literature:													
a. Spoken folk-literature	3/E									57	45	12	
b. Ancient Russian literature		3/R								48	36	12	
c. Literature of the 18th century			3/E							57	45	12	
d. Literature of the 19th century				4/R	3/R	4/E				173	113	60	
e. Literature of the 20th century							3/E			30	30		
f. Soviet literature								2	3/E	95	75	20	
Total	3	3	3	4	3	4	3	2	3	460	344	116	
12 Foreign literature:													
a. Ancient literature		2/R								32	32		
b. Literature of the Renaissance, Middle Ages, and 17th century			2/E							38	38		
c. Literature of the 18th century				2/R						32	32		
d. Literature of the 19th century					3	2/E				80	80		
e. Literature of recent times							2	3/E		68	68		
Total		2	2	2	3	2	2	3		250	250		
13. Foreign language	12/E	10/E	12/E	10/E	12/RE	10/RE	10/E	10/RE	8/E	1,562		1,562	
14. Latin language	2	2/R								60		60	
15. Methods of teaching Russian					2	2/R	3/E			100	52	48	
16. Methods of teaching literature					2/R	2/R				70	38	32	
17. Methods of teaching foreign language						3/R	3/E			70	40	30	
18. Special courses (Russian language or literature)									4/E	84	84		
19. Special seminars (Russian language or literature)								2/R	2/R	74		74	
20. Special training	1	2/R								48		48	
21. Physical education	2/R	2/R	2/R	2/R						140		140	
Total hours	34	34	33	34	32	32	30	28	22	4,574	1,692	2,882	

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester								
	1		2		3		4		5
	1	2	3	4	5	6	7	8	9–10
1	2	3	4	5	6	7	8	9	10
Exams (36)	3	5	3	4	2	5	4	5	5
Reports (33)	3	6	4	4	5	4	4	2	1
Projects (3)	-------	-------	-------	-------	-------	1	-------	1	1

TEACHER TRAINING (19 wks.)

1. In Pioneer camps (3 wks. in the 6th semester)
2. In schools (8 wks. in the 7th semester and 8 wks. in the 9th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Logic (70 hrs.)
2. Practical training in conducting extracurricular and out-of-school activities (100 hrs.)
3. A modern Slavonic language (60 hrs.)
4. Literature of the People's Democracies (60 hrs.)
5. Practical training in expressive reading (60 hrs.)
6. Improving sports skills (420 hrs.)
7. Choral singing (250 hrs.)
8. Individual instruction in playing musical instruments (250 hrs.)

Table M. — Specialty: Foreign languages

Subjects	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (19 weeks)	2 (16 weeks)	3 (19 weeks)	4 (16 weeks)	5 (19 weeks)	6 (13 weeks)	7 (13 weeks)	8 (16 weeks)	9 (19 weeks)	10				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	3/R	4/E	3/R	4/E							224	120	104	
2. Political economy					2/R	3/E	2/R	3/E			140	98	42	
3. Dialectical and historical materialism							2/R	3/E	4/E	4	140	80	60	
4. Psychology	2	3/E									84	50	34	
5. Pedagogy			4	3/RE							120	70	50	
6. History of pedagogy					2	3/E					72	54	18	
7. School hygiene							2/R				36	18	18	
8. Introduction to linguistics	2	2/E									80	80		
9. Latin language	2	1/R									60		60	
10. Methods of teaching foreign languages					2	2/R	2	2/R	-/E		120	50	70	
11. Phonetics of foreign languages	6/E	6/R	4/E	4/R	2/E	2/R	2/E				438	20	418	
12. Grammar of foreign language	6/R	6/E	6/R	6/E	4/R	2/R	2/R	2/E			578	60	518	

For meaning of R and E symbols, see note on page 217.

13. Practical training in spoken (foreign) language	7/RE	6/RE	4/RE	4/RE	6/RE	6/RE	5	5	8	8	854	-------	854	-------
14. Analysis of texts and written practice	4	4	4	4	4	2	2/R	2/RE	2/RE	2	476	-------	476	-------
15. Translation	-------	-------	-------	-------	-------	-------	-------	2/R	2/R	2	70	-------	70	-------
16. Lexicology	-------	-------	-------	-------	2/R	2/E	-------	-------	-------	-------	64	34	30	-------
17. History of language	-------	-------	-------	-------	-------	-------	2	3/RE	-------	-------	72	52	20	-------
18. Literature in the foreign language studied	-------	-------	-------	2	2/R	2/E	-------	-------	-------	-------	96	96	-------	-------
19. Second foreign language	-------	-------	4/R	5/E	6/E	8/R	8/E	8/R	10/RE	10	800	-------	800	-------
20. Recent history of the country speaking the language studied	-------	-------	-------	-------	-------	-------	3/R	-------	-------	-------	36	36	-------	-------
21. Special training	-------	-------	3/R	-------	-------	-------	-------	-------	-------	-------	48	-------	48	-------
22. Physical education	-/R	2/R	2/R	2/R	-------	-------	-------	-------	-------	-------	140	-------	140	-------
23. Practical training in audio-visual techniques	2	-------	-------	-------	-------	-------	-------	-------	4/R	4	76	30	46	-------
Total hours	34	34	34	34	32	32	32	30	30	30	4,824	948	3,876	

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (33)	2	5	2	5	3	5	2	5	4	.....
Reports (43)	4	4	6	4	5	5	6	5	4	.....
Projects (3)	.....	.....	.....	.....	.....	.....	1	1	1	.....

TEACHER TRAINING (19 wks.)

1. In Pioneer camps (3 wks. in the 6th semester)
2. In schools (6 wks. in the 7th semester and 10 wks. in the 9th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activities (100 hrs.)
2. History of the country speaking the language studied (20 hrs.)
3. History of the culture of the country speaking the language studied (40 hrs.)
4. Geography of the country speaking the language studied (40 hrs.)
5. Russian language (120 hrs.)
6. Literary style (40 hrs.)
7. Special course in philology (120 hrs.)
8. Special seminar in philology (120 hrs.)
9. Foreign literature (40 hrs.)
10. Improving sports skills (420 hrs.)
11. Logic (70 hrs.)
12. Choral singing (250 hrs.)
13. Individual instruction in playing musical instruments (250 hrs.)

Table N. — Specialty: Mathematics and physics

Subjects	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (18 weeks)	2 (16 weeks)	3 (18 weeks)	4 (16 weeks)	5 (18 weeks)	6 (16 weeks)	7 (12 weeks)	8 (16 weeks)	9 (18 weeks)	10				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	4/R	3/E	3/R	4/E							224	120		104
2. Political economy					2/R	3/E	2/R	3/E			140	98		42
3. Dialectical and historical materialism							2/R	3/E	4/E	4	140	80		60
4. Psychology	3	2/E									84	50		34
5. Pedagogy			4	3/RE							120	70		50
6. School hygiene						1/R					36	18		18
7. History of pedagogy					2	3/E					72	54		18
8. Mathematical analysis	6/RE	6/RE	6/RE	6/RE							408	204		204
9. Analytical geometry	6/RE	4/E									172	86		86
10. Projective and descriptive geometry					4/E	3/R					110	78		32
11. Foundations of geometry									4/E	4	64	54		10
12. Higher algebra	4/RE	3/R	4/E								192	104		88
13. Theory of numbers						3/E					48	36		12
14. Foundations of arithmetic							3/E				36	36		
15. Theory of functions of a real variable						3/E					50	50		

16. Theory of functions of a complex variable					2/E						54	54		
17. Special seminar in mathematics or special practical training in physics								3/R	2/R	2	84			84
18. Elementary mathematics	4	2/RE	4/R	4/E	4/R	3/R	3/E				400	180	16	204
19. Methods of teaching mathematics						5/R	4/E	2/R	2/R	2	194	92		102
20. Special practical training (mathematical models, surveying, calculation)							2/R	2/R	2/R	2	92		92	
21. Mechanical drawing	3/R	2/R									86	18	68	
22. General physics		8/RE	9/RE	9/RE	9/RE						620	272	204	144
23. Theoretical mechanics							4/R	4/E			112	56		56
24. Astronomy									4/E	4	72	54	18	
25. Methods of teaching physics						6/R	3/R	2/E	2/R	2	210	60	100	50
26. Practical training in school work-shops with elements of technology of materials				4/R	3/R	4/R					188	32	150	6
27. Electrical and radio engineering							4/R	5/R			140	48	80	12
28. Machine technology with practical training in auto-tractor technology								6/R	5/R	5	190	54	130	6
29. Educational movies							3/R				36		36	
30. Special course (elective)									3/R	3	54	54		
31. Foreign language	2/R	2/R	2/E	2/R							140			140
32. Physical education	2/R	2/R	2/R	2/R							140			140
33. Special Training					3/R						48			48
34. Pedagogical practice in extracurricular activity					4/R						60			60
Total hours	34	34	34	34	34	34	30	30	28	28	4,818	2,114	1,810	894

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (35)	4	5	4	5	3	4	3	4	3	----
Reports (55)	7	7	5	6	6	6	7	5	6	----
Projects (4)	----	----	----	1	----	1	----	1	1	----

TEACHER TRAINING (18 wks.)

1. In the school (6 wks. in the 7th semester and 10 wks. in the 10th semester)
2. Industrial (2 wks. in the 10th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activity (100 hrs.)
2. Methods of mathematical physics (40 hrs.)
3. Differential geometry (40 hrs.)
4. Theory of probability (40 hrs.)
5. Methods of approximate calculation (40 hrs.)
6. Algorithms and computing machines (40 hrs.)
7. Modern algebra (40 hrs.)
8. Nuclear physics (40 hrs.)
9. Physics of semiconductors and dielectrics (40 hrs.)
10. Aerodynamics (40 hrs.)
11. History of physics (40 hrs.)
12. History of mathematics (40 hrs.)
13. Selected topics in elementary mathematics (40 hrs.)
14. Special topics in the methodology of physics (40 hrs.)
15. Improving sports skills (420 hrs.)
16. Foreign language (in years 3 and 4, 140 hrs.)
17. Choral singing (250 hrs.)
18. Individual instruction in playing musical instruments (250 hrs.)

Table O. — Specialty: Mathematics and mechanical drawing

Subject	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (18 weeks)	2 (16 weeks)	3 (18 weeks)	4 (16 weeks)	5 (18 weeks)	6 (13 weeks)	7 (13 weeks)	8 (16 weeks)	9 (18 weeks)	10				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	3/R	4/E	3/R	4/E							224	120	104	
2. Political economy					2/R	3/E	2/R	3/E			140	98	42	
3. Dialectical and historical materialism							2/R	3/E	4/E	4	140	80	60	
4. Psychology	2	3/E									84	50	34	
5. Pedagogy			3	4/RE							120	70	50	
6. History of pedagogy					2	3/E					72	54	18	
7. School hygiene						1/R					36	18	18	
8. General physics			5/R	5/RE	6/R	6/RE					356	160	66	130
9. Astronomy									4/E	4	72	54		18
10. Theoretical mechanics							4/R	4/E			112	56	56	
11. Mathematical analysis	6/RE	7/RE	6/RE	6/RE							424	204	220	
12. Theory of functions of a complex variable					4/E						72	54	18	
13. Theory of functions of a real variable							2	2/E			50	50		
14. Analytical geometry	6/RE	4/RE									172	86	86	
15. Differential geometry					4/E						64	50	14	
16. Projective and descriptive geometry					4/E	3/R					110	78	32	

For meaning of R and E symbols, see note on page 217.

17.	Foundations of geometry									4/E	4	64	54	10	
18.	Higher algebra	4/R	4/E	4/RE								208	104	104	
19.	Foundations of arithmetic						3/E					38	38		
20.	Theory of numbers					4/E						60	36		
21.	Special courses (elective)								3/R	2/R	2	84	84		
22.	Special seminar in mathematics or methods of mathematics						2/R	2	2/R	2/R	2	118		118	
23.	Algorithms and computing machines									3/R	3	50	50		
24.	Elementary mathematics	4/E	3/R	4/R	4/E	4/R	3/R	3/E				402	180	206	16
25.	Methods of teaching mathematics						6/R	4/E	2/R	2/R	2	194	92	102	
26.	History of mathematics								3/E			48	48		
27.	Special practical training (surveying, mathematical models, calculation)							3/R	2/R	3/R	3	116			116
28.	Projective and technical drawing with methods of teaching	3/R	2/R	2/R	2/R	2/R	2/E					216	48		168
29.	Fundamentals of machine technology	2	2/R									80	34	12	34
30.	Educational movies							3/R				36			36
31.	Foreign language	2/R	2/R	2/E	2/R							140		140	
32.	Physical education	2/R	2/R	2/R	2/R							140		140	
33.	Special training				3/R							48		48	
	Total hours	34	33	31	32	32	32	26	24	24	24	4,290	2,050	1,722	518

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (35)	3	5	3	5	4	5	2	5	3	-------
Reports (52)	7	7	7	7	4	6	5	4	5	-------
Projects (4)	-------	-------	-------	1	-------	1	-------	1	1	-------

TEACHER TRAINING (21 wks.)

1. In Pioneer camps (3 wks. in the 6th semester)
2. In school (6 wks. in the 7th semester and 10 wks. in 10th semester)
3. Industrial (2 wks. in the 10th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activities (100 hrs.)
2. Foundations of modern algebra (40 hrs.)
3. Topology (40 hrs.)
4. Analysis of functions (40 hrs.)
5. Calculation of variations (40 hrs.)
6. Vector and tensor analysis (40 hrs.)
7. Methods of mathematical physics (40 hrs.)
8. Methods of approximate calculations (40 hrs.)
9. Nomography (40 hrs.)
10. Theory of surfaces (40 hrs.)
11. Theory of probability (40 hrs.)
12. Mathematical statistics (40 hrs.)
13. Mathematical logic (40 hrs.)
14. History of modern mathematics (40 hrs.)
15. Selected topics in elementary mathematics (40 hrs.)
16. Foreign language (in years 3 and 4, 140 hrs.)
17. Improving sports skills (420 hrs.)
18. Choral singing (250 hrs.)
19. Individual instructions in playing musical instruments (250 hrs.)

Table P. — Specialty: Physics and the fundamentals of production

Subject	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (19 weeks)	2 (16 weeks)	3 (19 weeks)	4 (16 weeks)	5 (19 weeks)	6 (13 weeks)	7 (13 weeks)	8 (16 weeks)	9 (18 weeks)	10				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	3/R	4/E	3/R	4/E							224	120	104	
2. Political economy					2/R	3/E	2/R	3/E			140	98	42	
3. Dialectical and historical materialism							2/R	3/E	4/E	4	140	80	60	
4. Psychology	2	3/E									84	50	34	
5. School hygiene						1/R					36	18	18	
6. Pedagogy			3	4/RE							120	70	50	
7. History of pedagogy					2	3/E					72	54	18	
8. Foreign language	2/R	2/R	2/R	2/E							140		140	
9. Physical education	2/R	2/R	2/R	2/R							140		140	
10. Analytic geometry	5/E	4/RE									158	88	70	
11. Mathematical analysis	7/RE	5/E	7/RE	4/E							410	232	178	
12. Methods of mathematical physics					4/E						76	56	20	
13. Mechanical drawing	3/R	2/R									86	18		68
14. General physics		9/RE	9/RE	9/RE	9/RE						636	272	160	204
15. Theoretical physics						5/E	6/E	6/E	6/E	6	334	218	116	
16. Theoretical mechanics					4/R	4/E					128	64	64	

17. Special practical training in physics								4/R	4/R	4	136			136
18. Special course in physics (elective)									3/E	3	54	54		
19. Astronomy with methods of teaching					6/R	4/E					160	100		60
20. Methods of teaching physics						6/R	5/E	2/R	2/R	2	210	60	50	100
21. Methods of teaching courses on the bases of production							1	2	1/R	1	70	12	26	32
22. Educational movies				3/R							48			48
23. Technology of metals and materials with practical training in school shops	5/R	2/R	6/R	4/R							310	56	6	248
24. Technical mechanics							3	3/E			86	48	6	32
25. Machine technology with practical training in auto-tractor technology							5	4/R	4/E	4	190	54	6	130
26. Electrical engineering					3/R	4/R					114	38	6	70
27. Radio engineering							6/R	3/R			120	44	6	70
28. Pedagogical practice in extracurricular activities					2	2/R					60		60	
29. Special training	3/R										48		48	
Total hours	32	33	32	32	32	32	30	30	24	24	4,530	1,904	1,428	1,198

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (31)	2	5	2	5	2	5	2	4	4	-------
Reports (43)	7	6	6	5	5	4	3	4	3	-------
Projects (4)	-------	-------	-------	1	-------	1	-------	1	1	-------

TEACHER TRAINING (23 wks.)

1. In the school (8 wks. in the 7th semester and 8 wks. in the 10th semester)
2. Industrial training in repair workshops, factories and electric plants, and at machine-tractor stations (3 wks. in the 6th semester and 4 wks. in the 10th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activities (100 hrs.)
2. Improving driving skills (automobile or tractor) (80 hrs.)
3. Nuclear physics (40 hrs.)
4. Physics of semiconductors and dielectrics (40 hrs.)
5. Physics of electronic phenomena (40 hrs.)
6. Special course in optics (40 hrs.)
7. Hydrodynamics and aerodynamics (40 hrs.)
8. Geophysics (40 hrs.)
9. History of physics (40 hrs.)
10. Special topics in the methodology of physics (40 hrs.)
11. Selected chapters of general chemistry (80 hrs.)
12. Improving sports skills (420 hrs.)
13. Foreign language (140 hrs.)
14. Choral singing (250 hrs.)
15. Individual instruction in playing musical instruments (250 hrs.)

Table Q. — Specialty: Biology, chemistry, and the fundamentals of agriculture

Subject	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5					
	1 (18 weeks)	2 (12 weeks)	3 (18 weeks)	4 (12 weeks)	5 (18 weeks)	6 (12 weeks)	7 (13 weeks)	8 (12 weeks)	9 (16 weeks)	10 (16 weeks)	Total	Lectures	Laboratory	Practical work or seminar
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	3/R	5/E	4/R	3/E							224	120	104	
2. Political economy					3/R	2/E	3/R	2/E			140	98	42	
3. Dialectical and historical materialism							3/R	3/E	4/E	4	140	80	60	
4. Psychology	2	4/E									84	50	34	
5. Pedagogy			4	4/RE							120	70	50	
6. History of pedagogy					2	3/E					72	54	18	
7. School hygiene						2/R					36	18	18	
8. Inorganic chemistry	7/RE	9/RE									234	120		114
9. Analytic chemistry			5/R	5/R							150	18		132
10. Organic and biochemistry				6/RE	6/RE						180	84		96
11. Foundations of physical and colloidal chemistry					4/R	6/RE					142	78		64
12. Fundamentals of chemical technology								2	4/RE	4	88	56		32
13. Botany	5/R	4/RE	4/E	5/RE							270	140		130
14. Physiology of plants					2	4/R	4/RE				140	80		60

For meaning of R and E symbols, see note on page 217.

15. Bases of agriculture					4/E	5/R	3/E	4/RE			220	110		110
16. Mechanization of agriculture					2	2/R	2	3/R			120	24		96
17. Zoology	5/E	4/RE	4/R	5/RE							270	140		130
18. Histology w. embryology	4/RE										72	36		36
19. Anatomy of man					5/RE						90	38		52
20. Physiology of man and animals							4/R	4/RE	5/RE	5	180	100		80
21. Darwinism							3	3/RE			70	50		20
22. Geology	4/E	4	2/RE								160	110		50
23. Methods of teaching chemistry						4	4/E	2	2/RE	2	156	50		106
24. Methods of teaching natural science and fundamentals of agriculture						4	4/R	3/R	2/RE	2	168	62		106
25. Special practical training (elective)								4	4/R	4	112			112
26. Special course (elective)									3/R	3	48	48		
27. Foreign language	2/R	2/R	2/E	2/R							140		140	
28. Physical education	2/R	2/R	2/R	2/R							140		140	
29. Special training			3/R								48		48	
30. Pedagogical practice in extra curricular activities					4/R						60		60	
31. Educational movies			2/R								36		36	
Total hours	34	34	32	32	32	32	30	30	24	24	4,110	1,834	750	1,526

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (35)	4	5	3	5	3	3	3	5	4	-------
Reports (52)	6	5	7	7	5	6	5	5	6	-------
Projects (4)	-------	-------	-------	1	-------	1	-------	1	1	-------

TEACHER TRAINING (45 wks.)

1. In the school (6 wks. in the 7th semester and 10 wks. in the 10th semester)
2. Fieldwork (6 wks. in the 2nd semester, 6 in the 4th and 7 in the 6th)
3. Working experience with the bases of agriculture and methods of teaching natural science and the fundamentals of agriculture (8 wks. in the 8th semester)
4. Workshop experience in chemical technology (2 wks. in the 10th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activities (100 hrs.)
2. Geography of plant-life with fundamentals of ecology (40 hrs.)
3. Geography of animal-life with fundamentals of ecology (40 hrs.)
4. Genetics and breeding of agricultural animals and plants (40 hrs.)
5. Agricultural entomology (40 hrs.)
6. Agricultural microbiology (40 hrs.)
7. Apiculture (40 hrs.)
8. Mineral resources (40 hrs.)
9. Chemistry of complex compounds (30 hrs.)
10. Selected chapters in the technology of inorganic substances (30 hrs.)
11. Practical training in construction of visual aids (60 hrs.)
12. Improving sports skills (420 hrs.)
13. Foreign language (in years 3 and 4, 140 hrs.)
14. Choral singing (250 hrs.)
15. Individual instruction in playing musical instruments (250 hrs.)

Table R. — Specialty: Geography and biology

Subject	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (19 weeks)	2 (13 weeks)	3 (18 weeks)	4 (13 weeks)	5 (19 weeks)	6 (13 weeks)	7 (19 weeks)	8 (17 weeks)	9 (11 weeks)	10 (19 weeks)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	4/R	3/E	4/R	3/E							224	120	104	
2. Political economy			2/R	3/E	2/R	2/E					140	98	42	
3. Dialectical and historical materialism							3/R	3/E	3/R	4/E	140	80	60	
4. Psychology	3	2/E									84	50	34	
5. Pedagogy			3	5/RE							120	70	50	
6. History of pedagogy					2	3/E					72	54	18	
7. School hygiene							1/R				36	18	18	
8. Fundamentals of topography and cartography		5/RE	4/R								136	68		68
9. Fundamentals of general earth science	3/E	3/R	6/E								204	136		68
10. Physical geography of the U.S.S.R.					4/R	5/E	3/R	3/E			220	148	26	46
11. Physical geography of the parts of the world					4/E	5/R	3/E				198	134	26	38
12. Economic geography of the U.S.S.R.						6/R	3/E	3/R	3	3/E	216	144	27	45
13. Economic and political geography of foreign countries							4/R	5/E	4/R	5/E	200	138	30	32
14. Practical training in the study of regions								4/R	3/R		64			64

15. Methods of teaching geography							4/R	4/E			104	52		52
16. Chemistry	5/RE	6/RE									180	96		84
17. Botany	4/R	4/E	4/E	5/E							270	140		130
18. Zoology	4/R	4/E	4/R	5/E							270	140		130
19. Physiology of plants					4	3					116	64		52
20. Physiology of man and animals							5/RE	4/R	3/R	3/E	180	100		80
21. Human anatomy					4/RE						76	38		38
22. Darwinism									3	4/E	70	50		20
23. Methods of teaching natural science							4/R	4/E			104	44		60
24. Fundamentals of agriculture					4/R	3/RE					116	52		64
25. Geology	4/E	3/R	3/E								170	120		50
26. Elements of soil culture				6/R							78	39		39
27. Geography of animal life					2/R						38	38		
28. Geography of plant life					2/R						38	38		
29. Educational movies				3/R							36			36
30. Astronomy	3/R										56	38		18
31. Special course in geography or biology (elective)									2	2/R	40	40		
32. Special practical training and special seminars in geography or biology (elective)									5	5/R	100			100
33. Pedagogical practice in extracurricular and extra-school activities					2	2/R					60		60	
34. Foreign language	2/R	2/R	2/E	2/R							140		140	
35. Physical education	2/R	2/R	2/R	−/R							140		140	
36. Special training					2	1/R					48		48	
Total hours	34	34	34	32	32	30	30	30	26	26	4,484	2,347	823	1,314

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams (38)	3	5	5	5	2	5	3	5	-------	5
Reports (51)	7	6	5	5	6	6	7	3	4	2
Projects (4)	-------	-------	1	-------	1	-------	1	-------	-------	1

TEACHER TRAINING (43 wks.)

1. In the school (6 wks. in the 8th semester, and 10 wks. in the 9th)
2. Summer fieldwork (7 wks. in the 2d semester, 7 wks. in the 4th, 6 wks. in the 6th, and 7 wks. in the 8th)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in extracurricular and out-of-school activities (100 hrs.)
2. History of geographical discoveries (40 hrs.)
3. Geography of population (40 hrs.)
4. Economic cartography (38 hrs.)
5. Methods of geographical field observation (40 hrs.)
6. History of the National Economy of the U.S.S.R. (80 hrs.)
7. Ecology of plants (40 hrs.)
8. Ecology of animals (40 hrs.)
9. Apiculture (40 hrs.)
10. Sketching (40 hrs.)
11. Construction of visual aids (60 hrs.)
12. Practical study of agricultural machinery (60 hrs.)
13. Improving sports skills (420 hrs.)
14. Foreign language (in years 3 and 4, 140 hrs.)
15. Choral singing (250 hrs.)
16. Individual instruction in playing musical instruments (250 hrs.)

Table S. — Specialty: Physical education

Subjects	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5					
	1 (19 weeks)	2 (11 weeks)	3 (19 weeks)	4 (11 weeks)	5 (19 weeks)	6 (8 weeks)	7 (11 weeks)	8 (9 weeks)	9	10	Total	Lectures	Laboratory	Practical work or seminar
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. History of the C.P.S.U.	4/R	3/E	4/R	3/E							224	120	104	
2. Political economy			2/R	3/E	2/R	4/E					140	98	42	
3. Dialectical and historical materialism					2	4/E	3/R	4/E			140	80	60	
4. Psychology (including psychology of sports)	3	2/E						3/R			100	50	50	
5. Pedagogy			4	4/RE							120	70	50	
6. History of pedagogy					2	4/E					72	54	18	
7. Foreign language	2/R	2/R	2/E	2/R							140		140	
8. Chemistry	3/RE	4/E									104	54		50
9. Human anatomy	6/RE	6/RE									180	60		120
10. Human physiology			4/R	6/RE	6/RE						256	150		106
11. Methods of teaching human anatomy and physiology					2	2/R					54	20	14	20
12. General biology with fundamentals of Darwinism	4	3/E									112	66		46
13. Hygiene, general and of physical exercises					4/R	6/E					124	60	24	40

For meaning of R and E symbols, see note on page 217.

14. Physical therapy, medical supervision, athletic massage						3/R	6/R	6/RE			150	60		90
15. Organization and history of physical culture							5/R	4/E			96	70	26	
16. Theory and methods of physical education				4/R	4/R	3/E					142	60	82	
17. Gymnastics (fundamental, sports, and acrobatics) with methods of teaching	4	4/R	2	4/R	2	4/R	6/E	6/R			400	30	370	
18. Light athletics with methods of teaching:														
a. In the course of theoretical instruction	4/R		5/RE		4/RE						248	30	218	
b. During summer study camp		10/(R) (4 wks.)		10/(R) (4 wks.)							(80)	(10)	(70)	
19. Athletic games with methods of teaching														
a. In the course of theoretical instruction	2/R	2	2	2	4/R	2/R	4/E	2/R			274	30	244	
b. During summer study camp		8/(R) (4 wks.)		6/(R) (4 wks.)							(56)	(10)	(46)	
20. Skiing with methods of teaching														
a. In the course of theoretical instruction					2/RE						38	20	18	

b. During winter study camp		34/(R) (3 wks.)		34/(R) (3 wks.)							(204)	(10)	(194)	
21. Ice-skating with methods of teaching		2	2/RE								60	8	52	
22. Active games with methods of teaching														
a. In the course of theoretical instruction			2	2/R							60	14	46	
b. During summer study camp				4/(R) (4 wks.)							(16)	(4)	(12)	
23. Swimming and diving with methods of teaching														
a. In the course of theoretical instruction		2	2	2							82	10	72	
b. During summer study camp		12/(R) (4 wks.)		10/(RE) (4 wks.)							(88)	(10)	(78)	
24. Musical and rhythmic training	2	4/R									82		82	
25. Excursion training (*turism*)														
a. During summer study camp		4 (4 wks.)		6/(R) (4 wks.)							(120)	(22)	(18)	
b. Summer excursion (*letnii turistskii pokhod*)				X/(R)							(80)		(80)	
c. Winter excursion (*zimnii turistskii pokhod*) (optional) (48 hrs.)					X									
26. Special training			3/R								48		48	
Total hours	34	34	34	32	34	32	24	25			3,446 (564)	1,214 (66)	1,760 (498)	472

For meaning of R and E symbols, see note on page 217.

Item	Number of exams, reports, and projects by semester									
	1		2		3		4		5	
	1	2	3	4	5	6	7	8	9	10
1	2	3	4	5	6	7	8	9	10	11
Exams [27 (1)]	2	5	3	4 (1)	3	2	5	3		
Reports [40 (10)]	6	4 (4)	7	5 (6)	7	4	3	4		
Projects (3)					1	1	1			

TEACHER TRAINING

1. Pedagogical practice in physical education in schools with suspension of course attendance (6 wks. in the 6th semester)
2. Pedagogical practice in physical education, anatomy, and physiology in schools with suspension of course attendance (8 wks. in the 8th semester)
3. Winter study camp *(zimnii uchebnolagernyi sbor)* (3 wks. or 102 hrs. in the 2d semester and 3 wks. or 102 hrs, in the 4th semester, for a total of 204 hrs.)
4. Summer study camp *(letnii uchebnolagernyi sbor)* (4 wks. or 136 hrs. in the 2d semester, and 4 wks. or 144 hrs. in the 4th semester, for a total of 280 hrs.)
5. Summer hike *(letnii turistskii pokhod)* (10 days in the 4th semester for a total of 80 hrs.)
6. In the Pioneer camp (3 wks. in the 6th semester)

OPTIONAL COURSES *(fakul'tativnye distsipliny)*

1. Practical training in improving sports skills (600 hrs.) (for 1st-class athletes and masters of sports, 900 hrs.)
2. Automobile racing (100 hrs.)
3. Figure skating (70 hrs.)
4. Rowing (40 hrs.)
5. Bicycle racing (60 hrs.)
6. Shooting (60 hrs.)
7. Fencing (70 hrs.)
8. Mass folk and ballroom dancing (100 hrs.)
9. Athletic equipment (30 hrs.)
10. Practical training in cinema and photography (80 hrs.)
11. Choral singing (250 hrs.)
12. Individual instruction in playing musical instruments (250 hrs.)

APPENDIX IX

Curriculum for University

Specialty: Physics, Moscow State University (1957-58)[1]

Subject	Hours per week by school year and by semester										Number of hours			
	1		2		3		4		5		Total	Lectures	Laboratory	Practical work or seminar
	1 (18 weeks)	2 (16 weeks)	3 (18 weeks)	4 (16 weeks)	5 (18 weeks)	6 (16 weeks)	7 (18 weeks)	8 (13 weeks)	9 (13 weeks)	10 (16 weeks)				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Foundations of Marxism-Leninism	3/R	3/E	4/R	4/E							224	144	80	80
2. Political economy					2/R	3/E	2/R	2/E			140	100		40
3. Dialectical and historical materialism							2	3/E	5/E		140	80		60
4. History of physics									4/E		52	52		
5. Foreign language	4/R	4/R	4/R	4		R		R			270			270
6. Chemistry	4/E	2/R									102	68	34	
7. Mechanical drawing	2	2/R									68		68	
8. Teaching workshop	2	2/R									68		68	
9. Higher mathematics	10/ER	10/ER	10/ER	6/ER							616*	360		236

For meaning of R and E symbols, see note on page 217.

10.	Methods of mathematical physics					8/ER	7/ER					256	170		86
11.	Mathematical practicum					1	1/R					34		34	
12.	General physics	4/ER	6/ER	6/ER	6/ER							372	236		186
13.	Atomic physics					3/R	2/E					86	68		18
14.	Nuclear physics						3/R	3/E				102	68		34
15.	Theoretical mechanics and mechanics of continuous media				4/R	5/E						154	102		52
16.	Thermodynamics and statistical physics						2/R	4/E				104	68		36
17.	Electrodynamics					4/R	4/E					136	102		34
18.	Quantum mechanics							4/R	4/E			124	93		31
19.	Electronics fundamentals					3/E						54	54		
20.	General physics practicum	5/R	5/R	6/R	6/R							374		374	
21.	Atomic-nuclear physics and electronics practicum					6/R	6/R	9/R	9/R			483		483	
22.	Special course and seminar					4	6/R	6/ER	6/ER	6/ER	6/ER	424	345		79
23.	Laboratory in area of specialization								7/LR	14/LR	22/LR	625		625	
24.	Gym and sport	2/R	2/R	2/R	2/R							136			136
	Total hours	36	36	32	32	32	32	30	31	29	28	5,144	2,110	1,688	1,348

1 *Uchebnyi plan.* Fizicheskii fakul'tet, Moskovskii Gosudarstvennyi Universitet, (1957). (Curriculum. Department of Physics, Moscow State University, 1957).

See note on symbols on page 217.

I. SUBJECTS—Continued

Total laboratory reports	3
Total examinations	37
Total oral reports	47

II. OPTIONAL COURSES

	Semesters	*Hours*
Foreign language	5–8	120
Physical education and sport	1–8	420
Astrophysics	6–7	68
Preliminary seminar	1–6	204
Educational photography and film management	----	----

III. EXPERIENCE IN PRODUCTION WORK

Semester 8: 3 weeks (Aug. 10-31)
Semester 9: 5 weeks (Sept. 1–Oct. 5)

IV. TYPICAL COURSES OFFERED FOR AREAS OF SPECIALIZATION

Theoretical & Mathematical Physics	*Hours*
1. Theory of continuous media	68
2. Further topics in mathematical physics	34
3. Further topics in statistical physics	34
4. Further topics in electrodynamics	68
5. Quantum electrodynamics	68
6. Theory of relativity	68
7. Quantum chemistry	34
8. Theory of elementary particles	68
9. The atomic nucleus	34
10. Quantum theory of fields	34
11. Theoretical physics seminar	68
12. Qualitative theory of differential equations	34
13. Theory of functions of a real variable	68
14. Integral equations	34
15. Elliptic differential equations	34
16. Hyperbolic differential equations	34
17. Operational calculus	34
18. Analytic theory of differential equations	34
19. Computational techniques	34
20. Special seminar	68
TOTAL HOURS	952

Physics of Solids	*Hours*
1. Fundamentals of crystallography and X-rays	68
2. Structure analysis	68
3. Physico-chemical analysis	68
4. Roentgenography of metals	34
5. Special topics in physics of Xrays	34
6. Theory of solids	68
7. Electron theory of metals	34
8. Special topics in crystal chemistry	34
9. Physics of semiconductors	68

10.	Semiconductor devices	34
11.	Elements of high frequency technology	34
12.	Technology of semiconductors	34
13.	Crystallography	68
14.	Growth of crystals	34
15.	Crystal optics	34
16.	Crystal physics	68
17.	Alternating currents	34
18.	Electromagnetic and magnetic measurements	34
19.	Ferromagnetism	68
20.	Physics of metals	68
21.	Magnetic analysis	34
22.	Quantum theory of metals	34
23.	Special topics in quantum statistics	34
24.	Special methods of measurement	34
25.	Theory of transformers (regenerators)	34
26.	Theory of elementary particles	34
27.	Magnetic analysis of structured materials	34
28.	Special seminar	68
	TOTAL HOURS	1292

Optics & Spectroscopy

		Hours
1.	Spectroscopic technique	68
2.	Geometrical optics	34
3.	Spectrum analysis	34
4.	Theoretical optics	68
5.	Atomic spectroscopy	68
6.	Luminescence	34
7.	Theory of oscillations and waves	34
8.	Electronics (radio techniques)	34
9.	Molecular spectroscopy	68
10.	Further topics in nuclear physics	68
11.	Further topics in chemistry	34
	TOTAL HOURS	544

Molecular Physics

		Hours
1.	Further topics in mechanics of continuous media	34
2.	Fundamentals of theory of heat and mass transfer	34
3.	Molecular-kinetic basis of theory of condensed matter, I	34
4.	Special topics in thermodynamic and statistical physics	34
5.	Gas dynamics	34
6.	Independent student project	34
7.	Special seminar	68
8.	Molecular-kinetic basis of theory of condensed matter, II	34
9.	Physics of burning processes	68
10.	Method of (radioactive) indicator atoms	34
	TOTAL HOURS	408

Physics of Low Temperatures

		Hours
1.	Low temperature techniques	68
2.	Special topics in low temperature physics (experiments)	68

3.	Special topics in low temperature physics (theory)	102
4.	Special seminar	68
	TOTAL HOURS	340

Radio-Physics

		Hours
1.	Acoustics	34
2.	Theory of oscillations	102
3.	Electronics (radio techniques)	64
4.	Fundamentals of radiolocation	34
5.	Theory of waves	34
6.	Impulsive systems	34
7.	Special course	34
8.	" "	34
9.	" "	34
10.	" "	34
11.	" "	34
12.	Special seminar	68
	TOTAL HOURS	540

Geophysics

		Hours
1.	Geophysics	68
2.	Hydrodynamics	68
3.	Theory of turbulence	34
4.	Hydrometeorological measurements	34
5.	Thermodynamics of the sea	68
6.	Dynamics of the sea	68
7.	Hydrometry	34
8.	Physics of ground waters	34
9.	Physics of the atmosphere	102
10.	Oceanography	102
11.	Hydrochemistry	34
12.	Dynamics of river flow	34
13.	Optics of the sea	34
14.	Acoustics	34
15.	Molecular physics of the sea	34
16.	Seismology	34
17.	Seismometry	34
18.	Earth magnetism	34
19.	Gravimetrics	34
20.	Physical geology	34
21.	Thermodynamics and dynamics of the atmosphere	68
22.	Economics of the sea	68
23.	Theory of prognoses	68
24.	Synoptical meteorology	68
25.	Physics of the upper atmosphere	102
	TOTAL HOURS	1326

APPENDIX X

Topical Outlines of Required Courses in Education at Pedagogical Institutes

PEDAGOGY (120 hrs.)

A. Lectures (70 hrs.)
   1. General Theory of Education
      a. The subject and its methods (2 hrs.)
      b. Aim and tasks of Communist education (4 hrs.)
      c. Development and upbringing of children at various ages (2 hrs.)
      d. The system of public education in the U.S.S.R. (2 hrs.)
   2. Principles of Instruction and Didactics
      a. Nature of the teaching process (4 hrs.)
      b. Principles of didactics (4 hrs.)
      c. Contents of instruction (4 hrs.)
      d. The lesson (4 hrs.)
      e. Methods of teaching (6 hrs.)
      f. Theory of upbringing (2 hrs.)
      g. Tests and measurements[1]
   3. Moral and Aesthetic Education
      a. Principles of character education (6 hrs.)
      b. Education in Soviet patriotism and proletarian internationalism (2 hrs.)
      c. Education in Communist attitude toward work and public property (2 hrs.)
      d. Education in conscious discipline (2 hrs.)
      e. Aesthetic education (2 hrs.)
      f. Physical education (2 hrs.)
      g. Role of pupil groups (Pioneer and Komsomol organizations, and class groups) (8 hrs.)
      h. Extra-curricular activities (2 hrs.)
   4. School Management and Home Relations
      a. The teacher and the class leader (4 hrs.)
      b. Upbringing at home (2 hrs.)
      c. School administration (faculty council, control, etc.) (2 hrs.)

B. Practical exercises (50 hrs.)[2]
   1. Introduction (1 hr.)
   2. General acquaintance with the school (2 hrs.)
   3. The lesson (10 hrs.)
   4. Polytechnic education (8 hrs.)
   5. Work of the class leader (4 hrs.)
   6. Komsomol organizations (3 hrs.)
   7. Pioneer organizations (8 hrs.)
   8. Preparing pupils for summer pioneer camp (14 hrs.)
   9. Extra-curricular and other school-related activities (13 hrs.)

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[1] Although the official syllabus *(pedagogika)* published by the R.S.F.S.R. Ministry of Education in 1957 did not include this topic, Soviet educators told us that in fact it is covered in this course.

[2] The topics form a program of active field and practical experiences whereby actual school operations are studied.

HISTORY OF PEDAGOGY

Outline of textbook in history of pedagogy for pedagogical institutes[3]

Part 1. *Short Survey of the history of foreign education* (32.2 percent of text)

Education in primitive society.

Education, the school, and the origin of pedagogical theory in slave-holding society.

Education and the school in feudal society.

Pedagogical theory of Jan Amos Komensky (Comenius).

Pedagogical views of John Locke.

Pedagogical theory of Jean-Jacques Rousseau.

Pedagogical views of the French materialists of the 18th century (Helvetius, Diderot).

Pedagogical thought and the school during the period of the French bourgeois revolution of the 18th century.

Pedagogical theory of Johann Heinrich Pestalozzi.

Pedagogical theory of Johann Herbart.

Pedagogical activity and views of Adolph Diesterweg.

Pedagogical activity and views of Robert Owen.

Teaching of K. Marx and F. Engels on education.

Pedagogical thought at the end of the 19th century and the first half of the 20th century in Western Europe and the USA.

Part II. *History of Russian education* (39 percent of text)

Short survey of education and pedagogical thought in Russia from the 10th to the 17th century inclusive.

Enlightenment, schooling, and pedagogical thought in the 18th century.

School and pedagogy in the first half of the 19th century.

Pedagogical theory of Russian revolutionary democrats V.G. Belinskii and A.I. Hertsen.

Social-educational movement of the 1860's; the pedagogical views and activity of N.I. Pirogov.

The great Russian pedagog K.D. Ushinskii.

Revolutionary-democratic pedagogical theory of N.G. Chernyshevskii and N.A. Dobroliubov.

Pedagogical activity and views of L.N. Tolstoi.

School reforms of the 1860's.

School and pedagogical thought in the period of government reaction in the 1870's and 1880's.

Education, school, and pedagogical thought at the end of the 19th century

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[3] N. A. Konstantinov, E. N. Medynskii, *and* M. F. Shabaeva. *Istoriia pedagogiki.* (History of Pedagogy.) Moscow, Gos. uch.-ped. izdat., 1959. 497 p.

and beginning of the 20th century, and during the first Russian people's revolution of 1905-1907. The struggle of the Bolshevik Party for education and school at that time.

Public education and pedagogical thought in Russia during 1908-1917 (up to the Great October Socialist Revolution). The struggle of the Bolshevik Party for public education at that time.

Part III. *History of the Soviet school pedagogy* (26.2 percent of text)

V.I. Lenin on Communist up-bringing, education, and school.

The Great October Socialist Revolution and basic reforms in the field of education and up-bringing (1917-1920).

Soviet school and pedagogy (1921-1929).

Soviet school and pedagogy (1930-1941).

Soviet school and pedagogy in the years of the Great Patriotic War (1941-1945).

Soviet school and pedagogy during 1946-1958.

N.K. Krupskaia—life, pedagogical activity, and pedagogical views.

The outstanding Soviet pedagog A.S. Makarenko.

The outstanding Soviet State leader, M.I. Kalinin, on Communist education.

Part IV. *School and education in countries of the people's democracies* (2.5 percent of text)

APPENDIX XI

Sample State Examinations in Pedagogical Institutes

AT THE END of the 5-year program in pedagogical institutes students are required to pass what are called "State Examinations" in the specialties which they studied. The examination questions are prepared locally at the institutes by examining committees from a list of topics published by the Ministry of Education in each of the Republics. This list of examination topics is made available to the students in advance of their examinations. They are expected to be able to answer questions relating to these topics. On the manner of conducting the state examinations, see the text, page 184.

In the following pages are reproduced two examples of these examinations, one in physics and one in mathematics. These requirements have been in effect since 1957, when teacher education for secondary schools was increased to 5 years.

The State Examination in Physics in Pedagogical Institutes[1]

(Topics from which examining committees will prepare examination questions)

PROGRAM

Introduction

Matter and motion—Space and time. Marxian and Lenin philosophy as a basis of studying physical phenomena. Objective character of laws of nature. Interrelation of physics with engineering. Role of Russian and Soviet science in development of physics.

I. *Mechanics*

1. *Dynamics of rigid bodies.*—Understanding of force and mass. Newton's Laws. Inertial systems and the force of inertia. Centrifugal force and its meaning in technology. The motion of a rigid body. The center of mass. The motion of center of mass. Rotation of a rigid body around an axis. The moment of inertia. The moment of force. Momentum. The basic equations of dynamics in rotating motion.

2. *The law of conservation of energy.*—The law of conservation of momentum. Work, energy, and power. Kinetic and potential energy. Kinetic energy of a rotating body. The law of conservation of energy in mechanics. Application of law of conservation of energy.

3. *Oscillations and waves.*—Harmonic oscillations. Natural oscillations. Pendulum. Damped oscillations. Amount of dampening. Forced oscillations. Resonance and its meaning in technology. Diffusion of waves in elastic media. Transverse and longitudinal waves. Monochromatic plane wave equation. Interference of waves. Moving and standing waves.

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[1] Ministry of Education, R.S.F.S.R., *Programmy pedagogicheskikh institutov. Programma gosudarstvennykh ekzamenov po fizike.* (Syllabuses of Pedagogical Institutes, Program for State Final Examination in Physics.) Moscow, Uchpedgiz. 7 p.

4. *Hydrodynamics and aerodynamics.*—Stationary movement of an ideal liquid. Bernoulli's equation and technical applications. Laminar and turbulent flow of liquids. Motion of a body in viscous media. Head resistance. Resistance of media (Stokes' Law). Streamlining. Lifting capacity of an aeroplane wing. Understanding of treatise of Zhukovsky.

II. *Molecular Physics and Thermodynamics*

1. *The principle of kinetic theory of gases.*—Equation of state of an ideal gas. Lomonosov's idea. Derivation of equation of gas pressure from molecular-kinetic motion. Maxwell's distribution law concerning the speeds of molecules. Experimental definition of speed of the gas molecule. Mean free path of a molecule. Brownian motion. Definition of Avogadro's number.

2. *Thermal capacity.*—Theory of equal distribution of energy according to degrees of freedom. The classical theory of thermal capacity of gases and solid bodies, and its drawback. Quantum theory interpretation of thermal capacity.

3. *The real gases.*—Van der Waal's equation. Isotherms of Van der Waal. The works of Mendeleev, Andrews, and others. Internal energy of real gases. Joule-Thomson effect. Liquefaction of gases. How to obtain low temperature.

4. *Thermodynamics.*—The law of conservation and transformation of energy. Equivalence of heat and its performance. Mechanical equivalent of heat. The first law of thermodynamics. Isothermal, isobaric, isochoric, and adiabatic processes. Reversible and irreversible processes. Formulation of second law of thermodynamics. Circular process. Carnot's cycle. Entropy. Heat engines (steam engines, engines of internal combustion, and turbines) and their efficiency. Statistical interpretation of second law of thermodynamics. Interrelation between entropy and probability. Criticism of idealistic distortion in interpretation of second law of thermodynamics.

III. *Electricity*

1. *Electric field.*—Electric charge. Coulomb's Law. Intensity of an electric field in a vacuum and dielectric induction in the electric field. Flow of intensity. Flux. The theorem of Ostrogragsky-Gauss. Potentials. Interrelation between variation and intensity. Capacitance. Parallel plate capacitor. Energy of electric field. Electric field as a special type of matter. Electric apparatus: electroscopes, electrometers, and capacitors.

2. *Electron.*—Determination of the charge of an electron according to the method of Millikan. Movement of electrons in electric fields. Specific charge and mass of an electron.

3. *Direct current.*—Applied voltage. Electromotive force. Ohm's Law. Resistance of conductors. Kirchoff's Laws. Lenz-Joule Law and its application. Performance and power of current. Apparatus and methods of determining the power of current. Voltage and resistance.

4. *Electric current in electric lights and gases.*—Electrical dissociation. Electrical conductivity. Faraday's Law. Application of electricity in technology. Mechanism of conductivity of gases. Ionization of gases. Saturation currents. Cathode rays. Thermoelectric emission. The electron tube and its application.

5. *Magnetic field of a current.*—Laws of Biot-Savart and Laplace. Mag-

netic field near a straight wire and a circular coil. Ampere's Law. Movement of conductor with current in a magnetic field. Lorentz force. Determination of the specific charge of an electron.

6. *Electromagnetic induction.*—Discovery of the phenomenon. Lenz' Law. Derivation of law of induction based on law of conservation and transformation of energy. Self-induction. Energy in the magnetic field of a current. Energy density of a magnetic field. Practical application of electromagnetic induction.

7. *Alternating current.*—Methods of production and applications. Resistance, inductance, and capacitance in alternating current circuits. Ohm's Law for alternating current. Performance and power of alternating current. Three-phase current. Electrical measuring apparatus.

8. *Electric machines.*—Direct and alternating current, generators, and motors. Transformers. Rectifiers of alternating current. Applications of direct and alternating current. Electrification of the U.S.S.R. and the role played by Lenin in electrification of U.S.S.R.

9. *Electromagnetic oscillations.*—Thompson's formula. Damped and undamped oscillations. Excitation of undamped oscillations with the aid of an electron tube.

10. *Electromagnetic fields.*—Displacement current. Hypotheses of Maxwell. Equations of Maxwell. The speed of propagation of electromagnetic waves. Reception and detection of electromagnetic waves. Invention of radio by Popov. Broadcasting and reception of radio signals. Fundamental elements of radio apparatus.

IV. *Optics*

1. *Geometric optics.*—Reflection and refraction of light at the boundary between two dielectrics. Thin lens. Formulas of the thin lens. Magnification. Formation of an image by a thin lens. Optical apparatus: Photo apparatus, projectors, magnifying glasses, microscopes, astronomical telescopes. Focusing properties of these instruments and magnification.

2. *Interference of light.*—Coherent sources of light. Experimental proof of interference of light. The color of thin plates. Interference fringes of equal thickness and of equal inclination. Interferometers and their applications.

3. *Diffraction of light.*—Principles. Huyghen's principle. Fresnel. Diffraction of parallel light; the case of single or double slits. Diffractional gratings (screen or mesh as a method of production). Application of the diffraction grating.

4. *Speed of light.*—Astronomical and laboratory methods of determining speed of light. Phase and group speed.

5. *Optics of moving systems.*—Experiments of Fizeau and Michelson. The principle of special theory of relativity. Formulas of the Lorentz transformation (without conclusion) and conclusions from them. Interdependence of mass and speed. Interrelation between mass and energy.

6. *Quantum characteristics of light.*—Photo effect. Works of Stoletov. The fundamental laws of photo effect. Photons, their energy and momentum.

Einstein equation and its experimental confirmation. Photo elements and their applications. Pressure of light and its experimental proof by Lebedev.

7. *X-rays.*—Discovery of x-rays. Their characteristics. Diffraction of x-rays. The principle of structural analysis by means of x-rays. Spectra of x-rays. Compton effect. Production of x-rays and their application in medicine and technology.

V. *Nuclear Physics*

1. *Structure of atom.*—Nuclear model of the atom. Experimental proof of the existence of the nuclear atom. Postulate of Bohr. Electronic levels and shells. Experiments of Frank and Herz. The origin of spectra.

2. *Natural radioactivity.*—Discovery of radioactivity. Radioactive emission. Statistical law of decomposition. Radioactive series. The displacement law. Isotopes. Alpha disintegrations. Beta disintegrations.

3. *Elementary particles.*—Electron, proton, neutron, positron, and meson. Their discoveries. The methods of observation (spinthariscope, Geiger counter, Wilson chamber, and thin layer photo cells). Accelerators of particles (cyclotron and betatron).

4. *Wave-like characteristics of particles.*—Waves of de Broglie. Diffraction of electrons and its experimental realization. Principles of operation of the electron microscope, and its use for solution of problems.

5. *Atomic nuclei.*—Principal characteristics of the atomic nucleus: mass, charge, radius. Proton-neutron model of the nucleus according to Ibanenko. Periodic system of Mendeleev. Error in the metaphysical explanation about atoms as unchangeable particles. V. I. Lenin's theory on inexhaustible particles.

6. *Nuclear reactions.*—Mass defect. Energy relations in atomic nuclei. Splitting of nuclei. Some examples of nuclear reactions. Energy of reactions. Artificial radioactivity.

7. *Division of heavy nuclei.*—Fission of uranium under action of neutrons. Spontaneous fission. Chain reaction. Delayed neutrons. Reactors. Use of atomic energy for national economy in the U.S.S.R.

Explanatory Notes.—The purpose of the examination is to examine the preparation of graduates of pedagogical institutes for teaching physics in the secondary school. Each student will be examined in regard to the following.

1. Extent of the theoretical knowledge absorbed by the student during the course in physics.
2. Ability to apply this knowledge to problems in technology and in polytechnic education.
3. Knowledge of physical apparatus and measuring instruments and how to use them.

It is recommended that this entire program be broken up into a number of tickets (*bilety*) so that there be at least two questions taken from different subdivisions of the program.

The State Examination in Mathematics in Pedagogical Institutes[1]

(Topics from which examining committees will prepare examination questions)

Program

I. *Arithmetic*

1. Axiomatic structure of natural numbers. Principles of complete mathematical induction and its meaning for the secondary school course. Arithmetic processes.
2. Problems of understanding numbers (analysis of one of the following problems):
   a. Construction of whole numbers
   b. Construction of rational numbers
   c. Construction of complex numbers
3. Division of whole numbers. Common multiples and least common multiples of two or several numbers. Fundamental theorem concerning the factoring of natural numbers into primes. Presentation of the contemporary view on the problem concerning the distribution of prime numbers.
4. Basic characteristics of comparison. Complete and reduced systems of substraction. Theorems of Euler and Fermat. Arithmetic theory of the application of comparison.
5. Structure of real numbers. Decimal forms of real numbers.
6. Elements of approximation. Simple means of precise and approximate calculation.

II. *Algebra*

1. Investigation and solution of systems of n linear equations with n unknowns. Elementary methods of solving linear systems. Systems of linear equations with 2 and 3 unknowns and their geometric interpretations.

   General criteria for consistency of arbitrary systems of linear equations.
2. Equivalency of algebraic equations and systems of equations.
3. Solutions of algebraic inequalities and their geometric interpretations.
4. Number rings and fields. General theory of divisibility of polynomials into a product of irreducible factors.
5. Solution of second degree equations. Existence of roots of polynomials in in the field of complex numbers. Reduction of polynomials into linear factors. Integral and rational roots of polynomials.

III. *Geometry*

1. Relations between lines and planes in space. Study of this problem by the methods of elementary and analytic geometry.
2. Study of space curves by methods of differential geometry.

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[2] Ministry of Education, R.S.F.S.R., *Programmy pedagogicheskikh institutov. Gosudarstvennye ekzameny po matematike.* (Syllabuses of Pedagogical Institutes. Program for State Final Examination in Mathematics.) Moscow, Uchpedgiz, 1958. 6 p.

3. Projective invariance of elements of the first degree. Projective limitations of a curve of the second degreè. Problem of constructing a curve of the second degree, using five points (lines). Theorems of Pascal, Brianchon.
4. Geometry and groups of transformations. All collinear groups in a plane and the most important subgroups. Characteristics of various branches of the geometry of invariant groups.
5. Basic understanding of geometry as a postulate system. The system of axioms of elementary geometry. The axiomatic method of construction in geometry (derivation of some theory).
6. Concept about consistency and independence of the axiom system. Analytical interpretation of the axiom system of Euclid's plane geometry.
7. Independence of the axiom of parallelism from other axioms. Interpretation of geometry of Lobachevskii.
8. Problems based on plane constructions. The system of postulates on construction with aid of compass and ruler. Survey of basic methods of solving the problems. Criteria of solution of problems based on construction with compass and ruler.

IV. *Mathematical Analysis and Theory of Functions*

1. Sets and operations. Countable sets and their basic properties. Noncountability of the continuum of real numbers.
2. Sets of real numbers and their basic properties. Existence of upper and lower bounds of bounded sets. Limit points of sets of numbers. Theorem of Bolzano and Weierstrass.
3. Numerical sequences. Concept of the limit of a number sequence and its properties. Existence of limits of monotone sequences. Necessary and sufficient conditions for convergence of sequences.
4. Concept of functional dependence. Determination of limits of function. Functions continuous at a point and classification of points of discontinuity. Properties of continuous functions on closed and bounded sets.
5. Derivatives and differentials of functions of one variable and their geometric and physical interpretations. Differentiability of functions of two variables. Conditions for differentiability.
6. Applications of differential calculus in the study of functions of one variable.
7. Definite integrals. The theorem of existence of the definite integral. Plane area and the length of a curve, and their calculation with aid of definite integrals.
8. Numerical series. Concept of convergence. Conditions for convergence. Absolute and conditional convergence. Power series and their basic properties.
9. Exponential and logarithmic functions and their basic properties.
10. Functions of a complex variable. Power series in the complex domain. Concept of analytic continuation and the uniqueness theorem. Definition of basic elementary functions with aid of power series.

11. Ordinary differential equations, their solution and integral curves. Initial conditions. Linear equations of second order with constant coefficients and their applications in oscillation theory.

Explanatory notes.—The purpose of the State examination in mathematics is to give a thorough check on the preparedness of graduates of pedagogical institutes who are to teach mathematics in secondary schools, particularly:

1. The extent of their theoretical knowledge.
2. Their ability to apply mathematical methods in the solution of problems in the natural sciences and engineering.
3. Their ability to solve problems in elementary mathematics which require knowledge of methods and ideas of higher mathematics.

In conducting State examinations it is recommended that the program should be divided up into tickets (*bilety*) so that each ticket should contain 2 or 3 questions taken from different subdivisions of the program. After student has answered the assigned questions, it is recommended that additional questions be given from subdivisions not included on the ticket. The answer of the student to each question should include example or interrelated proof of his understanding of the question.

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